# International legal and regulatory issues of climate geoengineering governance: rethinking the approach

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## Climate Geoengineering Governance (CCG)

Climate Geoengineering Governance (http://geoengineering-governance-research.org) is a research project which aims to provide a timely basis for the governance of geoengineering through robust research on the ethical, legal, social and political implications of a range of geoengineering approaches. It is funded by the Economic and Social Research Council (ESRC) and the Arts and Humanities Research Council (AHRC) - grant ES/J007730/1

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What the working papers have in common is that they will all be at an early stage of development, prior to full publication. Comment and response, at any level of detail, is therefore doubly welcome. Please send all responses in the first instance to the authors themselves - each paper contains a correspondence address. We will be looking for opportunities to use the website or other project activities to give a wider airing to any dialogues and debates that develop around a paper or issue.

## About the Authors

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# International legal and regulatory issues of climate geoengineering governance: rethinking the approach[1]

Chiara Armeni & Catherine Redgwell

## Introduction

In less than a decade, there has been a detectable increase in the legal scholarship addressing geoengineering.[2] The term "geoengineering" encompasses a variety of techniques aiming at the 'deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change'.[3] Building upon divergent scientific views on the risks and benefits of individual methods, the legal literature has been focusing on legal, regulatory and institutional questions and options for geoengineering governance. Away from traditional forms of government control, the notion of "governance" answers the question of 'how decisions are made and who makes them'.[4] With reference to climate change, governance regimes have been increasingly viewed as embracing multi-level, decentralised decision-making processes; interaction between States and networks of non-state actors; and modes of societal coordination.[5] However difficult to pin-down, this framework shares some features (and limits) with the nature of international law as a fragmented, decentralised and horizontal system of norms, rules and institutions.[6] In the context of technological change, governance has been described as the 'intersection between power, politics, and

[1] The research for this working paper was substantially completed by February 2014, though it has been possible to take account of some subsequent legal developments.

[2] "Legal scholarship" here is understood in the broad sense of scholarship that considered issues associated with regulation of geoengineering, which transcends the narrow category of scholarship by lawyers in legal journals. The origins of the legal literature in this field can be traced back to the mid-1990s: see D. Bodansky, 'May We Engineer the Climate?' (1996) 33 *Climatic Change* 309.

[3] Royal Society, *Geoengineering the Climate – Science, governance and uncertainty* (2009), 1; see also the Experts Group Report, *Impacts of Climate-Related Geoengineering on Biological Diversity* UNEP/CBD/SBSTTA/16/INF/28 (5 April 2012), p. 17, which defines it as 'A deliberate intervention in the planetary environment of a nature and scale intended to counteract anthropogenic climate change and/or its impacts'. Others prefer "climate engineering" to emphasise the ultimate goal of counteracting climate change, e.g. E.A. Parson and L.N. Ernst, 'International Governance of Climate Engineering' (2013) 14 *Theoretical Inquiries in Law* 307.

[4] J.L. Dunoff, 'Levels of Environmental Governance' in D. Bodansky, J. Brunnée, E. Hey, *Oxford Handbook of International Environmental Law* (OUP, 2007) 86. For a review of the vast literature on governance, K.A. Armstrong, 'The Character of EU law and Governance: From 'Community Method' to New Modes of Governance' (2011) 64 *Current Legal Problems* 179.

[5] Among many, J. Scott 'The Multi-Level Governance of Climate Change' in: P. Craig and G. de Búrca, *The Evolution of EU Law* (OUP, 2011), 805; R. Keohane, D. Victor, 'The Regime Complex of Climate Change' (2011) 9 *Perspectives on Politics* 7.

[6] V. Gowlland-Debbas, 'Issues Arising from the Interplay Between Different Areas of International Law, (2010) 63(1) *Current Legal Issues* 597; I. Osofsky, 'Is Climate Change "International"? Litigation's Diagonal Regulatory Role' (2009) 49(3) *Virginia Journal of International Law* 585.

institutions'.[7] Hence there is little doubt that law and regulation[8] play an important role as forms of governance.[9]

Mapping the main international law scholarship on geoengineering, this paper explores five fundamental governance questions. Section I analyses the boundaries of geoengineering techniques (the *"what are we regulating?"* question). Section II discusses the purpose and role of geoengineering regulation, including an overview of potential rationales and scenarios (the *"why are we regulating it?"* and *"should we regulate it?"* questions). The extent to which international norms and institutions would be applicable or, at least, adaptable to regulate geoengineering is then considered in section III (the *"how is, or how could, it be regulated?"* question). The paper then addresses the institutions and bodies likely to adopt, and with the capacity to enforce, geoengineering regulation (the *"who should be deciding"* question) [10] in section IV. Here an 'indicators approach' is adopted for the assessment of the legitimacy and effectiveness of the key treaty regimes which might play a role in the governance of Geoengineering. A detailed table applying these indicators is found in the Annex.[11] Issues associated with the distinction between regulation of geoengineering research and regulation of geoengineering deployment (the *"when is regulation applicable"* question), which will also have implications for how and whether to regulate) will be briefly illustrated in section V. As will become clear in this paper, this last question will also have broader implications for the previous governance questions, such as how and whether to regulate, depending on whether they arise in a research or deployment context.[12] Finally, section VI revisits general international norms applicable in the absence of treaty-based norms and institutions.

This paper does not pretend to give conclusive answers to these challenges. Nonetheless, it critically engages with the current debate, highlighting a) how authors have structured their research questions and why and b) what issues and

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[7] M. Leach, I. Scoones, A. Stirling, *Dynamic Sustainabilities–Technology, Environment, Social Justice* (Earthscan, 2010), 65.

[8] As opposed to law, "regulation" can be understood as the articulation of legal requirements into operational rules enforced by public authorities to constrain and/or enable behaviour and establish decision-making procedures over specific activities. In general, R. Baldwin, M. Cave, M. Lodge, *Understanding Regulation Theory, Strategy and Practice,* (OUP, 2nd ed. 2011).

[9] On the interaction between law and governance, J. Scott, G. de Búrca, 'New Governance, Law and Constitutionalism', in their *Law and New Governance in the EU and US*, (Hart Publishing, 2006).

[10] These two elements – i.e. competence to adopt regulation and capacity to enforce it- can in practice be bifurcated (e.g. Conference of the Parties to a treaty can adopt rules that are enforced by the States through their domestic legislation).

[11] See C. Armeni and C. Redgwell, 'Assessment of International Treaties Applicable, Or At Least Adaptable, to Geoengineering-related Activities through Indicators, *CGG Working Paper n 22* (Annex to CGG Working Paper 21), March 2015.

[12] It is acknowledged that not all commentators accept the desirability of a distinction between governance of research and governance of deployment: see, for example, R. Bodle and S. Oberthur (lead authors) et al., Ecologic Institute Berlin, *Options and Proposals for the International Governance of Geoengineering*, Climate Change 14/2014, Report No. (UBA-FB) 001886/E for the German Federal Environment Agency, p. 21. However, they reject a separation not only on the basis of what they perceive to be the absence of a clear-cut separation between them, but also because of the integration between governance regimes for research and deployment in their approach: 'In our design, research would fall within the scope of and be integrated into the general governance [structures] and the [general] prohibition [of geoengineering activities], but it could proceed on the basis of case-specific exemptions, based on an environmental impact assessment, independent expert advice, and provided it implies a small-scale intervention only.' (ibid.) This maps closely on the CBD approach, discussed further below.

gaps remain. It seeks to complement such body of literature by drawing attention to two main aspects. First, the present study stresses that the legal and regulatory implications of geoengineering governance are not limited to the intuitive realm of environmental controls. Rather, they are likely to require a much deeper analysis of other areas of international regulation, such as international trade, food security, intellectual property rights, and international security.[13] In this it identifies a gap in the legal literature on geoengineering governance. Owing to the embryonic stage of development of these methods, these wider issues are certainly not imminent, but should not be overlooked.

Second, the study emphasises the unfeasibility, and arguably undesirability, of any kind of one-size-fits-all approach to geoengineering governance. In this context, it criticises the prevailing formalistic approach to reviewing existing international treaties with the expectation to find a suitable pre-formed model for a governance framework. On the contrary, our analysis suggests that a functional approach, based on indicators, could be more valuable as a precondition to evaluate the ability of existing international treaties to provide an effective model for future geoengineering governance. While the results of such an approach might map onto proposals to locate geoengineering governance within an existing instrument, the emerging picture is far more likely to be a fragmented one owing to the heterogeneous nature of geoengineering techniques proposed and the proliferation of treaty regimes and institutions with issue and geographic-specific areas of focus.

An essential point underscoring why this governance 'patchwork quilt' is a likely outcome is that some treaty regimes are already concerned about the potential risks associated with geoengineering and are already responding within the scope of their competence and the degree of flexibility accorded to them by their governing instrument (the treaty text(s)) and by their contracting Parties.[14] A clear example is the response of the contracting Parties to the London Convention and Protocol (LC/LP) to the marine environmental impacts of field tests of ocean fertilization, with the adoption of an assessment framework for scientific research on ocean fertilization.[15] There is no doubt that protection of the marine environment from the adverse effects of substances dumped or placed in the oceans falls squarely within the remit of the LC/LP; equally clear is the fact that the object and purpose of this treaty, no matter how broadly interpreted, cannot extend to regulation of geoengineering as a whole owing to its substantive (protection of the oceans from dumping) and geographic (at sea) limitations. In this manner, as noted above, treaties may dynamically evolve and change

[13] And of course this diversity is reflected in the Climate Geoengineering Governance research project work packages of which this working paper forms a part.

[14] In the international legal literature these are often referred to as 'living instruments' which continue to evolve over time.

[15] The assessment framework tool developed by the Scientific Groups under the LC/LP (2010) provides the parameters for assessing whether a proposed ocean fertilisation activity is 'legitimate [reasonable] scientific research' consistent with the aims of the Convention. It includes: (i) the requirement for environmental assessment, including risk management and monitoring; and (ii) there is no 'exemption' threshold below which experiments exempt from assessment provisions, i.e. the Assessment Framework applies regardless of the size or scale of the project (but differentiation as to extent of information required). In 2013 this assessment framework was placed on a treaty footing (new annex 5) with the adoption of an amendment to the LP to regulate the placement of matter for ocean fertilization and mechanism to include other defined marine geoengineering activities ('future proofing'). See further discussion at p. 19 below.

through such action by the Parties.[16] Other regional seas agreements may follow suit with respect to marine geoengineering, as occurred in the case of CCS with responses both by the LC/LP and the regional OSPAR regime to adopt measures prohibiting CO2 dispersal in the water column or on the seabed, but providing for a regulatory regime to address sub seabed disposal.[17] At the same time CCS, albeit after lengthy consideration, was accepted under the CDM of the Kyoto Protocol.[18] This combination of approaches at different governance levels is a common feature of the fragmented and decentralised character of international law, with complex networks of global, regional, and bilateral approaches.[19]

Another example is the response by the Parties to the Convention on Biological Diversity (CBD), first to address the impact on marine biodiversity of ocean fertilization, and then to the biodiversity-related impacts of geoengineering in general.[20] Unlike the LC/LP then, the CBD has addressed geoengineering in general, but thus far only in the context of non-binding resolutions of the COP expressed in hortatory language.[21] As with the LC/LP – or any other treaty instrument for that matter – the scope of the Parties to act is limited by the object and purpose of the treaty, its subsequent interpretation/application by the Parties, and any further amendments or protocols adopted. Some commentators, in the search for an existing treaty to utilise as an initial 'one stop shop' for geoengineering governance, have identified the CBD for this role. For example, Bodle et al. focus on existing institutions for reasons, inter alia, of 'institutional economy', and conclude that the Convention on Biological Diversity (CBD) is 'the prime candidate for becoming the central institution recognised as the first point of contact'. [22]

Regardless of whether a single instrument emerges as a 'first point of contact' or, the more likely, a regulatory patchwork quilt emerges, coordination of institutional responses is a key issue. An example from the biodiversity context is the extensive inter-related web of treaties and institutions addressing aspects of species and habitat conservation essential to the conservation and sustainable use of biological diversity and sustainable use of its components. Seven treaty regimes are members, through their secretariats, of the Biodiversity Liaison Group which is led and coordinated by the CBD Secretariat.[23] Here the coordination of

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[16] See, generally, E. Bjorge, *The Evolutionary Interpretation of Treaties* (OUP, 2014) and C Tams, A Tzanakopoulos and A Zimmerman (eds), *The Research Handbook of Treaties* (Elgar, 2014).

[17] In 2006, the Contracting Parties introduced an additional category of substances 'carbon dioxide streams from carbon dioxide capture processes for sequestration' to Annex 1, thereby removing a legal barrier to the deployment of CCS activities offshore. Parties also agreed to amendments and subsequent guidelines that in conjunction with other provisions of the Protocol provide an integrated permitting framework for CCS activities.

[18] Decision 10/CMP.7, Modalities and procedures for carbon dioxide capture and storage in geological formations as clean development mechanism project activities, FCCC/KP/CMP/2011/10/Add.2 (15 March 2012) 15.

[19] While it is premature, Bodle et al. n 12 above, nonetheless refer to an emerging geoengineering global regime comprising action by the CBD and LC/LP.

[20] COP 9 Decision IX/16 2008 and COP 10 Decision X/33 2010 on biodiversity and climate change.

[21] As under the LC/LP, there is provision under the CBD both to adopt amendments to that instrument or additional Protocols – the Cartagena (Biosafety) Protocol and the Nagoya Protocol being cases in point.

[22] Bodle at al n 12 above, at p. 22.

[23] The seven agreements are: the CBD, RAMSAR, World Heritage Convention, Convention on Migratory Species, CITES, the International Plant Protection Convention and the International Treaty on Plant Genetic Resources for Food and Agriculture. Cooperation is fostered, inter alia, by the conclusion of (nonbinding) Memoranda of Understanding (MoUs) between the treaty secretariats. An example is a 1999 Memorandum of Understanding between the World Heritage Convention and the Ramsar Convention, which is an agreement between secretariats; between UNESCO, represented by the World Heritage Centre, and the Bureau of the

decentralised fragmented action by treaty bodies within their mandate which collectively contributes to the conservation of biodiversity and the sustainable use of its components is achieved by a non-binding cooperative arrangement amongst treaty secretariats lacking legal personality. A final example is the problem of biodiversity conservation in areas beyond national jurisdiction, a recognised governance gap in the law of the sea regime.[24] The Sargasso Sea Alliance was created by non-binding Declaration to coordinate action through a number of existing treaty institutions.[25]

## I. Boundaries of Geoengineering and associated legal questions

### Boundaries of the definition

From a technical perspective, geoengineering methods have been divided into two categories: Carbon Dioxide Removal (CDR) and Solar Radiation Management (SRM) techniques.[26]

CDR methods 'address the root cause of climate change by removing greenhouse gases from the atmosphere'.[27]These include: *land-based methods* (i.e. land use management, afforestation, reforestation and avoidance of deforestation; biochar and biomass-related methods; enhancement of weathering of carbonate and silicate rocks; and $CO_2$ from ambient air by means of air scrubbers (direct air capture)); and *ocean-based methods* (i.e. ocean fertilisation methods, aimed at increasing the rate of $CO_2$ transfer into the deep sea by manipulating the ocean carbon cycle through addition of nutrients (e.g. iron); and oceanic upwelling or down-welling modification methods. [28] SRM methods differ from CDR as they 'attempt to offset the effects of increased greenhouse gas concentrations by causing the Earth to absorb less solar radiation'.[29] SRM techniques hence include: *surface albedo approaches* for enhancing the reflectivity of the planet by making its surface brighter (e.g. white roof methods and brightening human settlements; use of more reflective crop varieties and grasslands; desert reflectors; reforestation); *cloud albedo enhancement* for cooling the Earth by whitening clouds over parts of the ocean through injection of cloud-condensing particles into the atmosphere; *stratospheric aerosols* for scattering sunlight back to space, through injection of sulphate aerosols (e.g. $SO_2$ and $H_2S$) into the stratosphere;

Ramsar Convention. The final preambular reference in the MoU notes the advantage of cooperation in increased effectiveness through mutual cooperation and avoidance of duplication of effort. In particular, Article I stresses the importance of cooperation to enable the Parties 'to identify and strengthen conservation of those sites of international importance which are recognised by both Conventions'. Article II sets out a 'statement of work' which is, in effect, a list of the modalities for cooperation.

[24] See the recent (2015) decision by the Ad Hoc Informal Working Group to convene a Preparatory Commission to develop over the next two to three years the text of a further agreement on biodiversity in ABNJ, supplementary to UNCLOS, to be considered for adoption by a Diplomatic Conference in 2018 or 2019.

[25] See further D Freestone and K K Morrison, 'The Sargasso Sea' *International Journal of Marine and Coastal Law* 29:2 (2014) 345-362 (including text of the 2014 Hamilton Declaration on Collaboration for the Conservation of the Sargasso Sea).

[26] On the distinction, see, amongst others, N.E. Vaughan, T.M. Lenton, 'A review of climate geoengineering proposals', *Climatic Change* (2011) 109:745–790. See also B. Lauden and J.M.T. Thompson (eds) *Geoengineering Climate Change – Environmental Necessity or Pandora's Box?*, CUP, 2010.

[27] Royal Society n 3 above, at xi.

[28] The following description of CDR and SRM techniques is based on the Royal Society (2009) analysis.

[29] Royal Society n 3 at xi.

and *space-based techniques* for reducing solar radiation by positioning sun-shields into space to reflect or deflect the solar radiation. As it will explained below, SRM techniques have already been recognised as giving rise to governance issues, owing not only to their negative - or positive - transboundary effects, but also to its potential for a swift and cheap deployment, even by individuals.[30]

From a legal perspective, clarifying the spatial boundaries of these techniques, and the activities involved, is essential in identifying jurisdiction (national vs. international), law-making authority and enforcement capacity. For instance, due to their encapsulated nature, land-based CDR methods and surface albedo approaches will mainly be regulated under national law, insofar as they do not have transboundary impact and in combination with other rules of international law that will indirectly address their (national) impacts (e.g. rules on protected areas within the State). In contrast, the unencapsulated dimension of ocean iron fertilization, stratospheric aerosols and cloud albedo enhancement makes these techniques more likely to require collective action through international rules, norms and institutions.[31]

Some early analysis defined geoengineering as a range of diverse climate modification activities linked by common features, such as a large scale; intentional, unnatural and novel character.[32] Keith refers to the 'scale, intent and the degree to which the action is [a] countervailing measure' to climate change as the three core attributes of geoengineering.[33] Recognising the limits of any technology-specific definition, Parson and Ernst point to 'rapidity, low-cost and imperfection' as the characteristics on the basis of which technologies should be included or excluded from the definition.[34] These common features have influenced the boundaries of the geoengineering discussion in the legal literature. This is apparent in the fact that more attention has generally been devoted to new, largely untested activities, such as ocean iron fertilization, space-mirrors and sulphate aerosol injection, than to other land-based CDR methods, such as air capture, white roofs and cool pavements, or reforestation. [35] Certainly the former pose new legal questions, such as how to control the consequences associated with the "termination effect" [36] and potential unilateral actions by States or non-state actors. But this is also linked to the sometimes fluid boundaries between mitigation and geoengineering.[37] This is especially evident with respect to land use and forest management techniques, which have traditionally been framed as mitigation and sink enhancement measures, as opposed to geoengineering.[38]

[30] Solar Radiation Management- Governance Initiative (SRM-GI), *Solar Radiation Management – the governance of research,* (December 2011).

[31] D. Humphreys, 'Smoke and Mirrors: Some Reflections on the Science and Politics of Geoengineering', *The Journal of Environment and Development,*20(2) (2011) 99, 105-106

[32] T. Schelling, 'The Economic Diplomacy of Geoengineering, *Climatic Change,* Vol. 33 (3) *(*1996) 303-307(5).

[33] DW.Keith, 'Geoengineering The Climate: History and Prospects, *Annual Review of Energy and the Environment* Vol. 25 (2000) 245-285, 247.

[34] Parson and Ernst, n 3 above.

[35] See M.G.Bronstein, 'Readily Deployable Approaches to Geoengineering: Cool Materials and Aggressive Reforestation', *Sustainable Development Law and Policy* Vol. 10(2) (2010) at 45.

[36] "Termination effect" refers to the serious consequences of an abrupt halt or a failure of the Geoengineering system. See D. Matthews, K.Caldeira, 'Transient climate-carbon simulations of planetary geoengineering', Proceedings of the National Academy of Sciences of the United States of America (PNAS) June 12, 2007 vol. 104 no. 24, 9949-9954.

[37] Keith, n. 33 above, at .246; see also, Vaughan and Lenton, n 26 above.

[38] Art.2 (a) (i) Kyoto Protocol

Similarly, carbon capture and storage (CCS) is a good example of this ambiguity. It has been almost unanimously considered as a mitigation technique, falling outside the definition of geoengineering.[39] However, its storage component can be used in geoengineering methods, (e.g. air capture) bringing $CO_2$ storage into the boundaries of geoengineering. Some authors have also referred to individual techniques without necessarily labelling them as geoengineering.[40] Depending upon their identification as mitigation as opposed to geoengineering activities, these techniques would be regulated under discrete legal rules as a result of their distinctive characterisation.

## Structures of the legal research

The main questions addressed by the international legal literature relate to:

- The regulatory gaps and challenges (e.g. lack of regulation and institutional framework; legal status of the activities and substances; jurisdictional scope; risk assessment and authorisation; liability and compensation; responsibility for transboundary harm; rules for termination; unilateral action of State and non-state actors; enforcement and dispute settlement);

- The applicability, or at least adaptability, of existing treaties and general rules of international law vs. the need for a bespoke legal framework;

- The distinction between regulation of research and regulation of deployment;

- The role of soft-law instruments and principles of international (environmental) law; and

- The role of voluntary codes of conducts and principles of geoengineering research.

But legal questions do not sit in a policy vacuum. Analogies with regulation of other technologies (e.g. CCS, nuclear, GMOs, and chemicals), the risks and uncertainties associated with them, as well as ethical issues and public perception of the technology, have also contributed to the legal debate of most geoengineering techniques.

Doctrinal analysis of the legal questions has followed different approaches.[41] Some authors have started to address some of these questions, such as the applicability of existing rules or the necessity of a bespoke framework for geoengineering, by reviewing existing sources of international law (e.g. customary international law,[42]

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[39] Royal Society n 3 above; Convention of Biodiversity, *Impacts of climate related Geoengineering on Biological Diversity, Note by Executive Secretariat,* (UNEP/CBD/SBSTTA/16/INF/28, 5 April 2012, sect.2.1-2.2. Cft. A. C. Lin, 'Geoengineering Governance' *Issues in Legal Scholarship*, Vol. 8: Issue 3 ('Balancing the Risks: Managing Technology and Dangerous Climate Change'), and Keith, n 33 above.

[40] K. Scott, 'The Day after tomorrow: Ocean $CO_2$ Sequestration and the future of climate change', *Georgetown International Environmental Law Review* (2005) 57-108.

[41] In most cases a combination of these approaches has been adopted.

[42] *Customary international law* can be defined as 'evidence of general practice accepted as law' (Art 38 ICJ Statute). It is in principle binding upon all States (except upon persistent objectors) and requires proof of: a) general and consistence state practice and b) a sense of legal obligation.

treaties,[43] and general principles[44]) to provide a comprehensive, horizontal discussion of the potential models for the full range of techniques.[45] Others have chosen to look at specific geoengineering technologies [46] or potential locations[47] applying a useful cradle–to-the-grave approach. Some scholars have focused their research on the implications of the distinction between research and deployment.[48] Finally, there is an emerging literature on the detailed analysis of discrete legal issues (e.g. compensation and liability; public participation; intergenerational equity).[49] Certainly, all these perspectives contribute to the legal debate on geoengineering. However few have attempted to engage with the preliminary question of what elements are necessary to measure/ascertain the suitability of a model to govern geoengineering techniques, if any. [50] As will be argued later in this paper, the latter seems a more compelling question.

## II. The rationales and scenarios for Geoengineering regulation

### Rationales for regulation

Different rationales for considering, or not considering, geoengineering have been offered in the legal literature. Some commentators view geoengineering as a bad idea, questioning the possibility of manipulating the climate as 'the ultimate state

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[43] *Treaties* are written agreements between States, or between States and International Organizations, establishing their Parties' legal rights and obligations with respect to a specific matter and governed by international law. A treaty is only binding on its Parties, unless it otherwise provides and the non-Parties expressly agree to be bound.

[44] Notwithstanding controversies on their meaning, *general principles of international law* (i.e. 'general principles recognised by civilised nations' under art.38 ICJ Statute") have been described as unwritten legal norms of a wide-ranging character, recognised in municipal laws of States and transposable at the international level (e.g., good faith). In the environmental law context, including for geoengineering, key principles stated in soft law (e.g. precautionary principle, intergenerational equity) are far more influential, even though not binding. See A. Zimmermann, C. Tomuschat, and K. Oehllers-Frahm (eds), *The Statute of the International Court of Justice – A Commentary* (2006). See in general, P.Birnie, A.Boyle and C.Redgwell, *International Law and the Environment,* 3rd Edition (Oxford University Press), 2009.

[45] E.g. D. Bodansky, 'Governing Climate Engineering: Scenarios for Analysis', Discussion Paper 2011-47, Harvard Project on Climate Agreements, Belfer Center for Science and International Affairs, Harvard Kennedy School *November 2011; C.* Redgwell, Geoengineering the Climate: Technological Solutions to Mitigation – Failure or Continuing Carbon Addiction? *Carbon and Climate Law Review* 2/2011.

[46] On Ocean Iron Fertilization, see e.g. D. Freestone and R. Rayfuse, 'Iron fertilization and international law', *Marine Ecology Progress Series* Vol. 364: 213–218,2008), 227-233; K..Scott, n 40 above, (2005); R.Rayfuse, 'Ocean Fertilization and climate change: the need to regulate emerging high seas uses', *International Journal of Marine and Coastal Law* 23 (2008) 297; J.E. Peterson, 'Can algae save civilisation? A Look at Technology, Law, and Policy regarding Iron Fertilization of the Ocean to Counteract the Greenhouse Effect, 6 *Colorado Journal of International Environmental Law and Policy* 61 (1995). On SRM, see e.g. W.Burns, 'Geoengineering the Climate: an overview of solar radiation management options, *Tulsa Law Review* Vol 46 (2012) 283; G. Winter, 'Climate Engineering and International Law: Last Resort or the End of Humanity?', *Review of European Community and International Environmental Law,* Vol 20, Issue 3 (2011), 277-289; Lin, n 39 above; SRM-GI report n 30 above.

[47] See e.g. P. Verlaan, 'Geo-Engineering, the Law of the Sea, and Climate Change', *Carbon and Climate Law Review*,4 (2009).

[48] E.g. J. Reynolds, 'The Regulation of Climate Engineering', 3(1) *Law, Innovation and Technology* (2011) 113–136.

[49] E.g. M.Buzl, 'Geoengineering Harms and Compensation', *Stanford Journal of Law, Science and Policy* (2011) 69; W Burns, 'Climate Engineering – Solar Radiation Management and its Implications for Intergenerational Equity', *Stanford Journal of Law, Science and Policy* (2011) 38.

[50] See, e.g. the SRM-GI report n 30 above. In the policy sphere, see also Blackstock, Jason J., and Arunabha Ghosh (2011) 'Does geoengineering need a global response – and of what kind? International aspects of SRM research governance,' *Background paper for the Solar Radiation Management Governance Initiative*, Royal Society UK, Chicheley, March, discussing the benefits and drawbacks of potential governance models, and comparing alternative international coordination strategies.

of hubris to believe we can control the Earth'.[51] Winter argues that both SRM deployment and large-scale research should be prohibited from the outset due to the uncertainty of its effects.[52] Burns considers it 'paradoxical and tragic that society is considering using [it] as a technology with potentially serious negative impact on the climate'.[53] From an intergenerational equity perspective, these methods have also been seen as 'the quintessential act of generational selfishness'.[54] At the other end of the spectrum, some support has been shown for the "Plan A approach" to potentially replace conventional mitigation.[55]

Others [56] have argued that these methods should only constitute a "Plan B" should mitigation be unsuccessful, resulting in up to 6º C global temperature rise by 2050.[57] Victor et al. have framed it as 'an emergency shield that could be deployed if surprisingly nasty climatic shifts put vital ecosystems and billions of people at risk.'[58] However this rationale does not fully answer the question of the trigger for resorting to geoengineering: when, how and by whom is such lack of success determined? Geoengineering has alternatively been valued for its ability to provide a "stop gap measure" or "technical fix". This rationale frames geoengineering as a temporary "bridging technology", until mitigation measures are fully deployed. [59] However, until more is known about these methods and their impact, such rationale is vulnerable to *inter alia* Collingridge's "control dilemma": until a technology is sufficiently developed, its impacts cannot be sufficiently understood in order to assess, regulate and control its deployment; but, at the same time, early regulation is necessary to control technological development and avoid negative impact.[60] Moreover, this rationale seems to neglect the issues associated with the termination effect linked to some of the methods that are likely to be deployed.[61]

Owing to delays and complexities in delivering emissions reductions, some scholars point to geoengineering as a policy option additional to conventional

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[51] JT. Kiehl, 'Geoengineering climate change: Treating the symptoms over the cause?' Vol 77(3-4) *Climatic Change* (2006),1. See also e.g. ETC Group, *Geopiracy – A case against Geoengineering,* (2010); A. Robock, '20 reasons why Geoengineering is a bad idea'. *Bulletin of Atomic Scientists*, 2008.
[52] Winter, n 46 above, at 288
[53] Burns, n 46, at 304
[54] Burns, n. 49 above, at 55
[55] See e.g., Teller et al., 'Active climate stabilisation: presently-feasible albedo-control approaches to prevention of both types of climate change, *Lawrence Livermore National Library* 2003;.A.Carlin, 'Global Climate Change Control: Is there a better strategy than Reducing Greenhouse Gas Emissions? 155 *University of Pennsylvania Law Review,*1401; S. Barrett, 'The Incredible Economics of Geoengineering', *Environmental and Resource Economics* Vol. 39, Issue 1 (2008), 45-54.
[56] E.g. UK House of Commons, Science and Technology Committee, *The Regulation of Geoengineering*, Fifth Report of Session 2009-2010 (HC 221), 18 March 2010. See also P.J. Crutzen,, 'Albedo enhancement by stratospheric sulphur injections: A contribution to resolve the policy dilemma? *Climatic Change* Vol 77, Issue 3-4, (2006), 211-220, 216; A.C. Lin, n 12 above.
[57] See International Energy Agency, *Energy Technology Perspectives 2012*, IEA/OECD 2012.
[58] D.Victor et al., 'The Geoengineering Option - A Last Resort against Global Warming?', *Foreign Affairs* (2009), 66
[59] Barrett, n 55 above. Keith, n 33 above.
[60] D. Colligridge '*The Social Control of Technology'* (London, 1982) Bloomsbury Publishing PLC. See S. Rayner,'The Geoengineering Paradox' (2010) 1 *The Geoengineering Quarterly* 7 acknowledging this dilemma in the context of geoengineering.
[61] This terminology takes a neutral approach on the desirability of any of these technologies.

mitigation and adaptation. [62] While concerns have been expressed that this approach would jeopardise mitigation actions,[63] there is general agreement that efforts towards mitigation should not be reduced.[64]

Regardless of these specific framings, most legal scholars recognise the need for fostering research to resolve uncertainties, increase knowledge and address risks.[65] More information is necessary to take collective decisions as to whether it is feasible and indeed desirable, to go down the geoengineering route. Irrespective of the merit of the individual arguments, a significant conclusion is that 'ignoring geoengineering is a recipe for bad, politics-led decision-making.'[66]

## Overlapping scenarios for regulation

There is a clear tendency in the legal scholarship to address geoengineering as a principally climate change or environmental matter. This clearly reflects the fact that the primary purpose of these activities is to counteract climate change. As a result, the applicability of multilateral environmental agreements, as well as environmental customary international norms and principles, has almost exclusively been investigated. Notwithstanding the legitimacy of this approach, some techniques have also demonstrated a potential for dual-use, raising implications for other legal and policy areas. While these remain underdeveloped concerns, a comprehensive approach to law and regulation of geoengineering must be aware of such complementary scenarios. Moreover they furnish the ground for analysis of a wider spectrum of relevant institutions and bodies apt to govern geoengineering activities.  These scenarios are discussed in this section. Of course these are not mutually exclusive framings, but rather likely to emerge as overlapping and/or overarching issues. They raise a series of distinct questions, in terms of the necessity of their direct and indirect regulation and control under international law.

### *Geoengineering as an International Security matter:*

Owing to the relative financial and technological feasibility of some geoengineering techniques (e.g. atmospheric aerosol injection), unilateral action on geoengineering by States or non-state actors could be possible.[67] This conduct

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[62] See e.g. Redgwell, n 45 above; see also P. Nurse, 'Third policy route - We hope we never need Geoengineering, but we must research it', *The Guardian* (2011).

[63] Amongst others, A.C. Lin,' Does Geoengineering represent a Moral Hazard?', UC Davis Legal Studies Research Paper Series No. 312 -  October 2012 (available at SSRN: http://ssrn.com/abstract=2152131). Yet the empirical evidence of moral hazard is scant. See e.g. Royal Society n 3 above.

[64] E.g. Royal Society, n 3 above; Blackstock et al. *Climate Engineering Responses to climate emergencies* (it cannot be a substitute for mitigation); TML Wingly, 'A combined mitigation/Geoengineering approach to climate stabilisation, (2008), 314 *Science*, 452; D.Victor, 'On the Regulation of Geoengineering', *Oxford Review of Economic Policy* (2008) 24 (2): 322-336;  J. Urpeleinen, 'Geoengineering and global warming: A strategic perspective' *International Environmental Agreements: Politics, Law and Economics* Vol.12 (2012) 375-389. A further question nonetheless is whether in reality insisting on 'mitigation as usual' is realistic given resource constraints.

[65] E.g. United States Government Accountability Office (GAO), 'Climate Change: A coordinated Strategy Could Focus Federal Geoengineering Research and Inform Governance Efforts', (September 2010); Royal Society, n 3 above; R.J.Cicerone, 'Geoengineering: Encouraging Research and Overseeing Implementation' (2006) 77 *Climatic Change*, 221.;Vaughan and Lenton, n 26 above.

[66] J.Virgoe, 'International governance of a possible geoengineering intervention to combat climate change, *Climatic Change* (2009) 95:103–119, 117.

[67] See discussion in K. Ricke at al., 'Unilateral Geoengineering - Non-technical Briefing Notes for a Workshop At the Council on Foreign Relations Washington DC, (May 2008) available at

could amount to a threat to international peace and security, should it be used – or be perceived –as a military weapon to intentionally alter the climate of other states and/or of areas beyond national jurisdiction. This scenario emphasises the potential implications for international stability and the risk of international conflicts arising from intentional or unintentional threats posed by geoengineering-related activities. As such, this scenario can result in *inter alia* geopolitical destabilisation and ecological stresses on communities within or outside national borders, resulting in migration, displacement and local tensions. Questions about the potential arrangements on the allocation of liability for damage – whether intentional, foreseeable or accidental– and on compensation of affected parties (or victims?) are raised by this scenario.[68] Under this scenario, the United Nations Security Council will have competence to take binding decisions under Chapter VII of the UN Charter where it is established that geoengineering – or its effects – constitute a threat or breach of the peace or act of aggression. Any binding action would, of course, be subject to the exercise of the veto by one of the Permanent five members of the UNSC (UK, US, China, Russia, or France). Geoengineering research, such as SRM, could also be framed in terms of national security, and its results be classified, exacerbating the perception of hostile purposes.[69] The use of environmental modifications for hostile purposes is not new in international law and is prohibited under the 1977 ENMOD treaty, which however remains an instrument of limited impact for the governance of geoengineering owing, inter alia, to its limited participation and the requirement of intentionality ('hostile purposes').[70]

***Geoengineering as a Food Security and International Trade matter:***
Thirty years ago, despite environmental and ethical concerns, the original debate around agricultural biotechnology was initially, and (over) enthusiastically, based on the assumption that these technologies would have solved the food security crisis as a vehicle to poverty eradication. [71] Today, beyond their climate manipulation purpose, some geoengineering techniques might -intentionally or unintentionally- also be used to manipulate food production and land-use in some geographic areas, by modifying monsoon cycles or crop and fish stock populations. Whereas some might see this as a positive impact of geoengineering,

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http://www.cfr.org/content/thinktank/GeoEng_Jan2709.pdf; Victor, n 64 above; J. Blackstock et al, *Climate engineering responses to climate emergencies,* Novim (2009); G Davis, "Law and Policy Issues of Unilateral Geo-engineering: Moving to a managed World", Social Science Research Network, (2009); 'On more sceptic views, J.Horton, 'Geoengineering and the Myth of Unilateralism – Pressure and Prospects for International Cooperation', *Stanford Journal of Law, Science and Policy* (November 2010)56-69.

[68] These questions associated with geopolitical diversity, stability and security constitute one of the work packages of the CGG project. See on this aspect: P. Nightingale and R. Cairns, 'The Security Implications of Geoengineering: Blame, Imposed Agreement and the Security of Critical Infrastructure', *CGG Working Paper no. 18.* November 2014, revised February 2015.

[69] J.Blackstock and J.Long, 'The politics of Geoengineering', *Science 29 January 2010: Vol. 327 no. 5965 p. 527;* I. Comardicea, A. Mass, 'Contextual Instability: The Making and Unmaking of Environment, (paper presented at annual international conference on "Security in Futures - Security in Change" on June 3-4 in Turku, Finland, available at http://www.adelphi.de/files/uploads/andere/pdf/application/pdf/contextual_instability_comardicea&maas_final.pdf)

[70] Convention on the Prohibition of Military or Any other Hostile Use of Environmental Modifications Techniques (Geneva) 16 *ILM* (1977). In force 5 October 1978. See Redgwell, n 45 above; J.R Fleming, 'The climate engineers', *Wilson Quarterly Spring* (2007) 45-60

[71] See Agenda 21, chapter 16. For a critical analysis of the (little) progress on that objective, see also *Report, Genetically Modified Organisms*, 2 para. 27. For a discussion, C. Redgwell, 'Biotechnology, Biodiversity and International Law, *Current Legal Problems,* Vol 28 (2005) p. 543

these changes are likely to have economic consequences upon international markets of food products and commodities.[72] A good example of potential dual-use of geoengineering can be seen in the ocean context. Ocean fertilization could unintentionally lead to enhanced fish production in areas adjacent to rapidly rising population.[73] However enhancing fish stock could also be the primary, intentional, objective of fertilization activities, regardless of their potential climate impact.[74] As for climate-related ocean fertilization, the legal regime applicable to such activities depends on where they take place, how, what substances are used, and by whom. [75] The core legal issues associated with these activities are likely to include: the protection of the marine environment and living resources under international law; the establishment and allocation of fishing rights under commercial agreements; and their regulation as project offset should ocean iron fertilization become eligible under the UNFCCC Clean Development Mechanism.[76] Interesting questions have also been raised about the societal acceptability of this technique. Amongst them, compensation has been suggested for communities relying on specific fish species that might be threatened directly by ocean fertilization, or indirectly by increase in other fish stocks.[77]

Yet the international trade implications of geoengineering-related activities might not be limited to this dual-use potential. The World Trade Organization (WTO) agreements provide sufficient adaptability to regulate these and other international trade aspects. However speculative, these might include: issues associated with restrictions on import of geoengineering-related commodities or services, to which the provisions of the GATT and GATS would apply; [78] conflicts between the protection of intellectual property rights (IPRs) on geoengineering-related goods and processes, and environmental concerns under the TRIPS regime;[79] or the regulation of trade volumes of food-related or chemical commodities connected with geoengineering activities, under the scope of the SPS regime.[80]

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[72] For a case study of these impact on Russia, F. Smith "Food Security and International Agricultural Trade Regulation: Old Problems, New Perspectives" in JA McMahon and M Desta (eds), *Handbook on International Agricultural Trade Regulation*, (Edward Elgar 2012), 31-49.

[73] See e.g. M.Markels 'Fishing For Markets – Regulation and Ocean Farming, 18 *Regulation* 73 (1995); ISF Jones, 'The Enhancement of Marine Productivity for Climate Stabilization and Food Security', in A. Richmond (ed) *Handbook of Microalgal Culture: Biotechnology and Applied Phycology,* (2004), 534-544.

[74] This claim was made by the Haida Salmon Restoration Corporation (HSRC) in relation the deposit of about 100 tonnes of iron sulphate off the west coast of Canada in 2013. See N. Craik, J. Blackstock and A.M. Hubert, 'Regulating Geoengineering Research through Domestic Environmental Protection Frameworks: Reflections on the Recent Canadian Ocean Fertilization Case', *Carbon and Climate Law Review* 2 (2013) 117-124.

[75] See discussion in J. Jabour Green, 'Legal and Political Aspects of Iron Fertilization in the Southern Ocean: Implications of Australia Involvement, *Environmental Policy and Law,*325 (2002).

[76] Art 12 United Framework Convention on Climate Change (Rio de Janeiro) 31 *ILM* (1992).On this point, W.Rickels, K.Rehdanz, A.Oschlies, 'Economic prospects of ocean iron fertilization in an international carbon market', *Resources and Energy Economics* 34 (2012) 129-150; C.Bentram, 'Ocean Fertilization in the context of the Kyoto protocol and the post-Kyoto process', *Energy Policy* 38 (2010) 1130-1139.

[77] Jones n 73 above, at 542.

[78] General Agreement on Tariffs and Trade 1947/1994; General Agreement on Tariffs and Services 1995.

[79] Agreement on Trade Related Aspects of Intellectual Property Rights (Marrakesh, 1994)

[80] Agreement on the Application of Sanitary and Phytosanitary Measures, 1995. For a comprehensive analysis of international trade issues, R Leal-Arcas, A.Filis-Yelaghotis, 'Geoengineering a Future for Humankind: Some Technical And Ethical Considerations, *Carbon and Climate Law Review* 2(2012) 128.

### *Geoengineering as an Intellectual Property Rights (IPRs) matter:*

Owing to their high-risk/high-reward potential, it has been suggested that these methods should be regulated as a public good.[81] This principle would impose a limit, or even a prohibition, on their patentability. A debate on IPRs in geoengineering technology is emerging, both in theory and in practice. On the one hand, private ownership of techniques encompassing unknown impacts and public sensitivity is undesirable. But on the other hand, granting IPRs can 'produce incentives for innovation by rewarding creators, [and] is also supposed to create a feedback mechanism that dictates the contours of information and innovation production'.[82] This could similarly apply to geoengineering innovation.[83] As such IPRs have been presented as a '*de facto* form of governance'.[84] Some commentators have warned about the risks of an unregulated increase in patent applications for a variety of these techniques.[85] In the UK, issues about patents over SRM techniques contributed to the cancellation of the Stratospheric Particle Injection for Climate Engineering (SPICE) in 2012.[86] Concerns that economic interests might influence ocean fertilization projects have also been addressed by the Parties to the London Convention and London Protocol (LC-LP).[87] This issue must then be taken into account not only for its direct implications for a transparent governance of the technology, but also for its broader effects on international trade and technology transfer between developed and developing countries. Like in other areas (e.g. pharmaceuticals, conservation of biodiversity), the implications of IPRs upon climate technology transfer remain controversial, with polarised views on the role of IPRs in supporting R&D and its impact on the access to technology from developing countries.[88] Should geoengineering become a reality, a similar debate on its technology transfer pathways is likely to emerge.

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[81] S. Rayner, C. Redgwell, J.Savulescu, N Pidgeon and T Kruger, (2009) 'Memorandum to the draft principles for the conduct of Geoengineering research', House of Commons Science and Technology Committee, Inquiry into the Regulation of Geoengineering. http://www.publications.parliament.uk/pa/cm200910/cmselect/cmsctech/221/221.pdf (hereinafter "Oxford Principles"); Asilomar Scientific Organization Committee, The Asilomar Conference Recommendations on Principles for Research into Climate Engineering Techniques, November 2010 (hereinafter "Asilomar Recommendations")

[82] J Boyle, 'The Public Domain: Enclosing the Commons of the Mind (Durham, NC, Duke University Press, 2008), 7.

[83] J. Long, S. Hamburg, J Shepherd, 'Climate - More ways to govern Geoengineering', 21 June 2012, Vol 486, *Nature* 323.

[84] S. Parthasarathy, et al., 'A public Good? Geoengineering and Intellectual property', *STPP Working Paper* 10-1 (2010), 14

[85] *Id*.

[86] P. Macnaghten, R., Owen, "Good Governance for Geoengineering, 17 November 2011, *Nature*, 293;Cressey, Cancelled project spurs debate over Geoengineering patents, Corrected 24 May, Vol 485 , Nature, 429;

[87] Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (London) 11 *ILM* (1972) ('London Convention') and 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, adopted 7 November 1996, 2006 ATS 11 (entered into force 24 March 2006) ('London Protocol'). See Resolution LC-LP 2 (2010) on the Assessment Framework for Scientific Research involving Ocean Fertilization, para 2(2) stating "economic interests should not influence the design, conduct and/or outcomes of the proposed activity. There should not be any financial and/or economic gain arising directly from the experiment or its outcomes[…]".

[88] N.Singh Ghaleigh, 'Barriers to Climate Technology Tranfer – The Chimera of Intellectual Property Rights', *Carbon and Climate Law Review,* 2(2011), 220.

***Geoengineering as an Ethical and Sustainable Development matter:***

Ethical issues and public perceptions associated with geoengineering have been widely discussed, especially outside the legal realm.[89] The role of law in this context is however inevitable and challenging. Legal issues are intertwined with ethical arguments in a number of ways: from how to ensure international consensus and public participation in the decision-making process; to how to distribute responsibility and liability; to how to provide for an equitable allocation of resources between mitigation and geoengineering and avoid moral hazard; to how to implement sustainable development and account for inter-generational equity. As for other technologies, these questions require law to deal with conflicting interests and values in decision-making.[90] Some steps have been taken by identifying public participation and access to research findings as key guiding principles for geoengineering research.[91]Although not addressing geoengineering as such, public participation, access to information and access to justice are also important pillars of national and multilateral environmental (e.g. Aarhus Convention, Espoo Convention)[92] and human rights law mechanisms. While a detailed account of these aspects is outside the scope of this report, it is important that geoengineering governance challenges are also framed against this background.

## III. Applicability, or at least adaptability, of international law

Individual methods differ among each other, and no one-size-fits-all instrument is likely to be effective. But there is little doubt that regulation is required. In most instances, this would be needed at the international level, due to the potential for transboundary, and even global impact, and/or damage to areas beyond national jurisdiction.[93] International law can serve an important function in constraining behaviour and restraining unilateral action; helping structure international and national discussion about geoengineering, and helping direct geoengineering governance to particular institutions.[94]

There is a wide body of literature discussing international norms likely to be relevant to the individual geoengineering techniques.[95] Such review has largely focused on existing international treaties, against the backstop of customary international law rules and general principles.

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[89] See eg Gardiner, 'The Desperation Argument of Geoengineering, *PS: Political Science and Politics*, 46.1, January 2013 (2010); P.Macnagthen,, B Szerszynski, 'Living the global social experiment; An analysis of public discourse on solar radiation management and its implications for governance', *Global Environmental Change, (*2013); S.M. Gardiner, *A Perfect Moral Storm: The Ethical Tragedy of Climate Change*, (OUP, 2011).

[90] See eg. M. Lee et al., 'Public Participation and Climate Change Infrastructure', *Journal of Environmental Law* (2013) 25(1):33-62 discussing these issues with respect to wind energy and CCS.

[91] E.g. Oxford Principles and Asilomar Recommendations, n 81 above.

[92] Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus) 38 *ILM* (1999); Convention on Environmental Impact Assessment in a Transboundary Context (Espoo) 30 *ILM* (1991).

[93] Parson and Ernst, n 3 above; Victor, n 64 above; Lawrence MG, Rayfuse R, Gjerde K, 'Climate Change Mitigation by Geo-engineering, Potential Side Effects, and the Need for an Extended Legal Framework: the Case of Ocean Iron Fertilization', *Global Investments for Climate and Energy Security – A cross sector perspective* (2008).

[94] Bodansky, n 45, at 18-19. On the functions of international law, see also R. Higgins, *Problems and Process: International Law and how we use it* (OUP,1995);

[95] Amongst others, Reynolds, n 48 above; Redgwell, n 45 above; R.J. Zedalis, 'Climate Change and the National Academy of Science's Idea of Geoengineering: One American Academic's Perspective on First Considering the Text of Existing International Agreements' 19 *European Energy and Environmental Law Review* (2010) 18; D. Bodansky, n 2 above.

With some variation, scholars have primarily asked the following questions:

- Does (or could) the treaty apply to the area where specific geoengineering methods are likely to take place?
- Does (or could) the treaty regulate the substances/activities involved by specific Geoengineering methods?
- Would any substantive standards, if any, apply (e.g. benchmarks, threshold of harm, etc.)?
- What institutional and enforcement machinery exist, if any?
- How widespread is participation? Is it a 'living instrument' or a 'sleeping treaty'? [96]
- To what extent can international law proactively manage these technologies as opposed to merely react and respond to ad hoc development?[97]

These questions have been addressed by reviewing a) treaties directly or indirectly applicable to *all* geoengineering techniques by reasons of their scope to regulate the activity itself or their impact (i.e. UNFCCC, ENMOD, CBD[98]) or b) treaties directly or indirectly applicable to *specific* techniques by reason of their geographic scope. For methods carried out in - or having an impact upon – the oceans, LOSC,[99] LC/LP and the Antarctic treaty regime[100] have been reviewed. For methods undertaken – or having an impact upon– the atmosphere or outer space, the LRTAP Convention,[101] the Montreal Protocol[102] and the Outer Space Treaty[103] have generally been considered. One key point of distinction between the oceans and the atmosphere is the area-based approach to regulation of the former, divided into recognised maritime zones.[104] While air space likewise has a spatial dimension, extending up through the stratosphere to outer space[105] and over which States have sovereignty and exercise full jurisdictional control,[106] in contrast the atmosphere is a 'dynamic and fluctuating substance' moving within and beyond borders in atmospheric circulations and jet streams.[107]

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[96] See Redgwell, n 45 above, at 182.
[97] K.Scott, 'Marine geo-engineering: A new challenge for the law of the sea', *ANSZIL 18th Conference (24-26 June 2010)* , 3.
[98] Convention of Biological Diversity (Rio de Janeiro) 31 *ILM* (1992)
[99] UN Convention on the Law of the Sea (Montego Bay) 21 *ILM* (1982)
[100] Antarctic Treaty (Washington) 1959; Protocol on Environmental Protection to the Antarctic Treaty, 30 *ILM* (1991). However, the Antarctic Treaty's scope is not limited to the sea, but covers activities onshore and offshore within the boundaries of its regional scope.
[101] Convention on the Long-Range Transboundary Air Pollution (Geneva) 18 *ILM* (1979)
[102] Protocol to the Vienna Convention on Substances that Deplete the Ozone Layer (Montreal) 26 *ILM* (1987)
[103] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and other Celestial Bodies 9 *ILM* (1967)
[104] E.g. the territorial sea, exclusive economic zone and the high seas.
[105] Though there is no agreement on, or clear horizontal delimitation of, where air space ends and outer space begins. See Murase, n 107 above at 53.
[106] Principally for defence and aviation purposes. See, for example, Article 1 of the Convention on International Civil Aviation (1944) which provides that 'every State has complete and exclusive sovereignty over the "airspace" above its territory', the latter comprising land territory and the adjacent territorial sea, but not beyond.
[107] A recent attempt defines 'atmosphere' as 'the layer of gases surrounding the earth in the troposphere and stratosphere, within which the transport and dispersion of airborne substances occurs': S Murase, Special Rapporteur First report on the protection of the atmosphere to the Sixty-sixth Session of the International Law Commission, A/CN.4/667, 14 February 2014, p. 47, para. 70 (Draft guideline 1).

As mentioned above, for encapsulated geoengineering methods within the territory of one State, principally national and potentially regional (e.g. EU) regulation would be applicable or required. However international obligations to, for instance, conduct an Environmental Impact Assessment or avoid activities that might impact on internationally protected areas remain applicable in the national and regional context.

In this respect, diverse conclusions have been drawn. While the applicability of ENMOD appears limited to a 'backstop function',[108] many have seen the UNFCCC regime as the natural incubator for a potential regulation and institutional framework of geoengineering to develop.[109] This is due both to its climate change-specific focus and to its institutional and enforcement structure. But issues remain, especially concerning weak political trust in this regime.[110] The CBD is an important regime with theoretically general scope and broad participation.[111] Its Contracting Parties have agreed to a prohibition to undertake ocean fertilization activities, 'until an adequate scientific basis on which to justify such activities, including assessing associated risks, and a global, transparent and effective control and regulatory mechanism is in place for these activities'.[112] However, its mandate (i.e. only conservation of biodiversity and sustainable use of biological resources), general obligations, and lack of enforcement mechanism restrict its potential.[113]

Marine activities benefit from a well-established governance framework, which could rather easily be adapted. LOSC – of which the US is not a party despite internal pressure to become so[114] - establishes the general jurisdictional framework for activities at sea, including specific provisions for marine scientific research and protection of the marine environment. Many of its provisions on environmental protection and marine scientific research will be applicable to ocean-based geoengineering as a matter of treaty law or, for non-parties such as the US, where reflected in customary law. In 2008 the Contracting parties to the LC-LP have considered ocean iron fertilization to be governed under the Convention's scope, resulting in a prohibition of this method, unless considered legitimate scientific research, and eventually leading to binding amendments to the Protocol in 2013.[115] The potential for these treaties to constitute a model for

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[108] Redgwell, n 45, at 183. above. But contra, see Bodle et at., n 12 above.

[109] See Reynolds, n 48 above; Lin, n 39 above; Peterson, n 46 above. .

[110] D. Bodansky, 'The Who, What and Wherefore of Geongineering Governance', *Climatic Change* (April 2013); Burns, n 49 above.

[111] Although not the US, who remains the only non-party to the CBD. For an overview on geoengineering and the CBD, see CBD Secretariat, 'Geoengineering in relation to the Convention on Biological Diversity: Technical and Regulatory Matters', Technical Paper, *CBD Technical Series* No 66 (2012).

[112] CBD COP Decision IX/16 (2008), para 4. An exception to this prohibition is provided for 'small scale scientific research studies within coastal water'. See discussion in Bodansky n 110 above, at 16 (noting that, due the non-binding character of COP decisions, this prohibition does not amount to a moratorium). See also, CBD COP Decision X/33 (2010) para 8; CBD COP Decision XI/20 (2012).para 8 and 11. For an analysis of the 2010 CBD decision, R.Bodle, 'Geoengineering and International Law: The Search for Common Legal Ground, *46 Tulsa Law Review,* 305 (2010).

[113] See Redgwell, n 45 above, at 188.

[114] In a marine context, the US is also a non-party to the London Protocol, while is a party to the original London Convention. See details in the Annex.

[115] Resolution LC-LP 1 (2008). For an analysis, R. Warner,' Marine Snow Storms: Assessing the Environmental Risks of Ocean Fertilization', *Carbon and Climate Law Review* 3 (4), (2009) 426-436. The parties subsequently adopted an assessment framework to inform decision making on a case-by-case basis. See Resolution LC-LP.2 (2010). See discussion on the 2013 amendments below.

SRM regulation has been suggested, but remain speculative.[116] Within its limited geographic scope, the Antarctic regime has also been indicated as a potentially effective framework to regulate geoengineering research and deployment activities in the Antarctic region, in combination with LOSC.[117]

The potentially applicable rules for SRM activities in the atmosphere and outer space are more fragmented and problematic. The Ozone Layer regime, the LRTAP regime[118] and the outer space treaty are all limited in scope and would require specific amendments to cover SRM methods. Little in-depth analysis has been conducted on other treaties of regional/indirect application, such as the Aarhus convention;[119] the OSPAR convention;[120] and the Espoo convention.[121]

From this overview three potential models for geoengineering governance can be considered:

***Hard track*[122]:** This model considers that binding treaty rules would be the most effective governance option. This approach suggests either applying, or extending, existing treaties[123]; or negotiating new bespoke agreements to govern geoengineering.[124]

***From soft to hard track:*** This model acknowledges the challenges associated with relying upon existing instruments and the unlikelihood of reaching consensus around an effective international treaty on geoengineering. Victor endorses it arguing that 'a decentralised process of research and assessment [...] can generate the information needed to assess different geoengineering options'.[125] He argues that this approach is likely to create the foundations to inform subsequent formal law-making. Some efforts in this direction can already be seen in the Oxford Principles for geoengineering research, the Asilomar recommendations, and initiatives to compile a draft code of conduct for geoengineering research. This has been considered as an 'effective and pragmatic

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[116] T. Markus. H. Ginsky, 'Regulating Climate Engineering: Paradigmatic Aspects of the Regulation of Ocean Fertilization, *Carbon and Climate Law Review* (2011) 477; Verlaan, n 47 above.

[117] P. Verlaan, 'experimental Activities that Intentionally Perturb the Marine Environment: Implications for Marine Environmental Protection and Marine Scientific Research Provisions of the 1982 United Nation Convention on the Law of the Sea, 31 *Marine Policy* (2007) 210 (but international guidelines are needed for MSR).

[118] This is a regional treaty open to UNECE Members, but covers some key players such as the UK, US, Germany and the European Community.

[119] Owing to a 2011 MOP decision to facilitate ratification by non-ECE parties, the Aarhus Convention could be considered no longer purely regional. See MOP Decision IV/5 on accession to the Convention by non-United Nations Economic Commission for Europe member States, as adopted 1 July 2011 (ECE/MP.PP/2011/CRP.3)

[120] Convention on the Protection of the North-East Atlantic (Paris) 32 ILM (1993?2)

[121] Winter, n 46 above, addresses ESPOO.

[122] International law distinguishes between hard (legal norms) and soft (non-legal norms). There is no uniform definition of 'soft law'. This phenomenon could however be neutrally defined as non-legally binding norms, such as standards, guidelines, code of conducts and principles, primarily developed by International Institutions and non-states actors (NGOs, business actors, scientific community) outside the formal - consensus-based - international law-making process. For a review of the legal implications, see e.g., P.M.Dupuy, 'Soft law and the International Law of the Environment', 12 *Michigan, Journal of International Law*, (1991) 420-453; C. Redgwell, 'International Soft Law and Globalisation', in Barton et al, *Regulating Energy and Natural Resources,* (OUP) 2006, 89.

[123] See e.g. Bodansky, n 110 above, Lin n 39 above.

[124] See e.g. Virgoe, n 66 above; Barrett, n 55 above.

[125] Victor, n 64 above, at 332.

approach', which would enable the establishment of a global, transparent and effective control and regulatory mechanism through non-binding instruments in the short term, but acknowledging the need for binding instruments in the long-term.[126]

***Soft-hard twin track:*** This model advocates for 'a number of guiding principles for the governance of geoengineering research, to be applied against the backdrop of a general prohibition on deployment, pending the fuller development of appropriate governance frameworks for the specific methods'.[127] Others have envisaged this to be an incremental step-by-step approach, suggesting slight changes to existing laws, plus additional voluntary commitments. [128] In both versions, a primary role can be assigned to guiding principles, such as the Oxford Principles and the Asilomar Recommendations.

All three models emphasise the absence of existing international mechanisms to address all aspects of geoengineering governance and prompt some kind of adaptation. Like other mitigation technologies, these options are all situated against the backdrop of the multi-scalar character of the climate change architecture more widely.[129]

## An indicator approach to assessing treaty suitability

Despite their value, the models discussed above stem from a rather formalistic approach to the ways in which international treaties might apply, or adapt, to geoengineering. It is argued here that, although useful, this approach overlooks the assessment of how these treaties - and related bodies - perform their functions and objectives in practice and in their wider political context. Assuming that 'form ever follows function', legal, regulatory and institutional arrangements should be understood and evaluated based on their ability to fulfil their functions and achieve their goals. [130] In other words, they should be judged based on their overall success and effectiveness, rather than on mere formal applicability and adaptability to the particular technique.

From this perspective then, the question of what key features make a treaty successful to achieve its aims and objectives appears pivotal- and possibly preliminary - to any investigation of suitable models to regulate geoengineering. This question could be addressed by recourse to a series of indicators, which have generally contributed to the success of international law instruments. These include elements related to the form and content of the treaty itself ("endogenous indicators") as well as factors associated with the context in which treaties are created, adapted and implemented ("exogenous indicators"). Expanding from Bodansky's analysis, our suggested indicators are listed below:[131]

***Legal Force***: mandatory obligations are traditionally considered to be more effective to influence States' behaviour. In some cases, however, non-binding

[126] Markus and Ginzky,n 116 above.
[127] Redgwell, n 45 above.
[128] Winter, n 46 above.
[129] Bodansky, n 45 above. Ososfky above n 6 above.
[130] L. Sullivan, 'The Tall Artistic Building Artistically Considered', *Lippincott's Magazine,* 57 (March 1896) 403-409,407.
[131] D. Bodansky, *The Art and Craft of International Environmental Law*, Harvard University Press, (2011) 264-265.

instruments have proved more acceptable, increasing compliance and promoting learning-by-doing.

***Precision of the obligations***: precise rules (e.g. targets, timelines and standards) provide stronger guidance and certainty to States. However, stringent standards can reduce participation in the regime.

***Decision-Making rules***: clear and transparent provisions on how the treaty, and parts of it, can be amended to adapt to evolving needs.

***Regulatory instruments and Incentives:*** the choice and balance of regulatory instruments and incentives affects the effectiveness of the treaty in a particular context (e.g. economic incentives, technological requirements; report and verification rules).

***Distribution of responsibility***: in some contexts, allocation of greater implementation responsibility to some parties (e.g. developed countries) might make the regime more effective and increase participation Differential treatments of this kind brings intergenerational equity concerns and the principle of common but differentiated responsibilities inside the treaty system.

***Treaty-Based Institutions:*** establishing an institutional framework (e.g. supervisory institutions, regular meeting of the parties, advisory bodies) maintains Parties' attention on implementation and shared goals, builds trust and facilitates regime's evolution. Clear mandate, functions, decision-making authority, and enforcement power are the most important features of the institutional design.

***Liability and Enforcement:*** the effectiveness of enforcement mechanisms is a primary, though not exclusive, reason for treaty success. A variety of enforcement instruments can be developed: from the more traditional- such as international responsibility and liability and dispute settlement – to more tailor-made, non-confrontational procedures – such as non-compliance procedures. Institutional supervision by the treaty's governing bodies is also an important form of implementation oversight/enforcement.

***Scientific Input in the Decision-making:*** involvement of scientific experts in the decision-making can provide a useful feedback-loop to ensure the treaty's efficacy, enable its dynamic evolution, and ensure adequate risk management. It can also constitute a supervision technique. In this context, transparent eligibility requirements, independence, and equitable geographic distribution of the experts are important.

***Degree of State Participation and Representivity:*** for multilateral environmental treaties, the number of ratifications and the Parties' representivity (e.g. developed/developing countries balance, or countries rich in biodiversity, or geographic representation) is an indication of the level of support and, indeed, their legitimacy and degree of compliance with it.[132]

***Degree of non-state actor participation and Representivity:*** provisions on NGOs and non-state actors' participation, as observers, to the evolution of a treaty and decision-making process enhance the legitimacy of the regime.

***"Future-Proofing":*** the ability of an instrument to evolve and be adaptable to future developments (e.g. new scientific knowledge) is an important condition for

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[132] The concept of legitimacy is blurred but can be described as 'the justification and acceptance of political authority'. When a legal regime is perceived as legitimate, the pressure for a State to comply with it is greater and goes beyond State self-interest or power. Theories of legitimacy are concerned with the factors determining legitimacy e.g. democracy, public participation or expertise. For a discussion, D.Bodansky, 'The legitimacy of International Governance: A coming Challenge of International Environmental Law?' (1999) 93 *American Journal of International Law* 596. See also Chayes and Chayes, *The new sovereignty: compliance with international regulatory agreements* (1995).

its effectiveness over time. On the reverse side, this should also take into account whether any 'exit strategy' (withdrawal, denunciation) needs to be accounted for.

A comprehensive table encompassing the details for each treaty considered can be found in the Annex.[133] Nevertheless, a review in this new perspective is likely to lead to different conclusions on their suitability, or desirability, as potential forms of geoengineering, than suggested thus far. In particular, it would provide a more comprehensive and sound assessment of the key factors contributing to the success of a treaty vis-à-vis its mandate and functions. This methodology is expected to result in a more realistic picture of pros and cons of governing geoengineering techniques under any given framework (if any) and place existing mechanisms in relation to each other in a more coherent and transparent way. Overall comparable indicators have not been systematically used in the existing literature on geoengineering. The following section of the report will provide an example of their application in practice to the Convention on Biodiversity and the LC/LP.

## IV. Applying an indicator-based approach towards geoengineering governance: the example of the Convention on Biological Diversity and the London Convention and London Protocol on dumping of wastes and other matter at sea.

As explained in the previous section, there are benefits in applying an indicator-based approach to the evaluation of the applicability, or adaptability, of existing international treaties to the regulation of geoengineering activities. Table 1 in the Annex provides a comprehensive analysis of how the indicators identified in the previous section might be applied to 1) treaties with universal scope, applicable to all Geoengineering Techniques and related activities; 2) treaties with specific scope, applicable to geoengineering methods and related activities in the atmosphere, the outer space and at sea; and 3) treaties of indirect application, which address specific aspects related to geoengineering activities, such as environmental impact and public participation in the decision-making.

In this section, a choice has been made to discuss and analyse the results of applying our 11 indicators to the Convention on Biological Diversity (CBD) and the London Convention and London Protocol on dumping of waste and other matters at sea (LC/LP). This choice has been determined by both the consideration by their Contracting Parties of the governance issues associated to geoengineering development under their frameworks; and the emerging academic and policy debate on their aptness to govern these techniques and their effects. In this context, the London Protocol is of particular interest owing to its recent amendments on marine geoengineering, establishing the first legally binding international mechanism for marine geoengineering activities.[134] Subject to their entry into force, the amendments allow for legitimate scientific research to be

[133] See C. Armeni and C. Redgwell, n 11 above.
[134] IMO, Resolution LC/LP 4(8) on the amendment to the London Protocol to regulate the placement of matter for ocean fertilization and other marine geoengineering activities (Adopted on 18 October 2013). The amendment will enter into force for those Parties which have accepted it on the 60th day after two-third of the Parties that have deposited their instrument of acceptance with the International Maritime Organization (Art 21. (3) (The US is not a Party to the Protocol). As of February 2014 no instrument of acceptance had been deposited with the IMO. For a discussion of the new mechanism, H.Ginzky and R. Frost, 'Marine Geo-Engineering: Legally Binding Regulation under the London Protocol', *Carbon and Climate Law Review* , 2 (2014) 82-96.

carried out for those geoengineering techniques listed in a new Annex 4, subject to a permit.[135] A binding Assessment Framework is included to inform the decision-making on the permit.[136] Although at the moment, the Annex only includes 'ocean iron fertilization', other marine geoengineering techniques can be added, making this mechanism future-proof to subsequent scientific developments.[137]

### Convention on Biological Diversity (CBD)

The CBD is an international treaty, open to universal participation and applicable to all activities having an impact on biodiversity and its conservation. It has a global scope of application including activities undertaken in the high sea. As such, its universality has led some to consider it as the most suitable mechanism to address all geoengineering techniques regardless their geographic area of deployment. However, a significant limitation derives from the dependency of its applicability upon whether biodiversity will be or likely to be affected by the activity.

But, when assessing the applicability, and adaptability/desirability, of the Convention as a global governance framework for geoengineering, other caveats do emerge. First, with respect to the precision of its obligations (Indicator 1), the Convention is a mere framework convention, establishing soft requirements and objectives. This approach leaves a large role to the national implementation measures, in order to operationalize the objectives and requirements through precise regulatory instruments and incentives (Indicator 2). These include: elaboration of the environmental impact assessment, the formulation of national plans, strategies and programmes; monitoring; adoption of appropriate legislative and administrative measures (e.g. establishment of protected areas). A lot is therefore left to the individual, and inevitably discretional, national decision-making process, including the adoption of incentive measures.

The CBD attributes a prominent role to the COP. Even though it is not granted formal law-making authority, COP decisions are influential and adopted by consensus (or as a last resort, 2/3 majority). A clear example in the geoengineering context is the recent COP decisions on ocean iron fertilization. The CBD also provide for a formal mechanism for its amendment, which might enable its adjustment to further geoengineering development, should the necessity arise (Indicator 3). The COP is also supported by a series of subsidiary bodies, including a Subsidiary Body on Scientific, Technological and Technical Advice (SBSTTA) with wide technical expertise, and a Clearing House Mechanism constituting a publicly accessible repository of information on biodiversity-relevant data.[138] This attention to scientific input is important and could provide a valuable tool in a geoengineering context, where scientific uncertainty and the necessity of research

[135] *Id.* new art 6bis.
[136] *Id.* new Annex 5 'Assessment framework for matter that can be considered for placement under Annex 4'. This generic framework is going to be complemented by the 2010 specific Assessment Framework on Scientific Research on Ocean Fertilization.
[137] *Id.* new Annex 4, para. 1(1) defines ocean fertilization as 'any activity undertaken by humans with the principal intention of stimulating primary productivity in the oceans'. IMO, 'Draft Guidance on a procedure for considering the inclusion of new activities in Annex 4 to the London Protocol'.
[138] Art. 18.3, CBD

and data collection are essential to inform decision-making (Indicators 6 and 8).[139]

Unlike other treaties, participation and representivity in the CBD in high. (Indicators 9 and 10). This is an important element when dealing with activities that might be deployed globally, have a transboundary -and even global- effect, and can also be deployed unilaterally (raising the issue of free-raiding, especially by non-party). There are 193 parties to the Convention, which however does not include the US, representing almost all developed and developing states. The Convention however does not assign differential treatment and responsibilities between developed and developing countries, making the instrument less flexible and adaptable to national circumstances and capabilities, including technological and financial ones. (Indicator 5). Participation and representivity of non-state actors also high, mainly from the environmental and business sectors. (Indicator 10).

As for other technological developments, what is important is also to assess the extent to which a treaty is able to address – and potentially adapt - to new scientific developments (Indicator 11). The CBD has already proved its ability and the willingness of its Parties to do so in various forms, both with respect to biotechnology development (e.g. Cartagena Protocol on Biosafety), but also to geoengineering concepts.[140] As a result, there is no doubt that existing mechanism for amendment and expansion of the treaty's scope provides engines for dynamism and future proofing.

The provisions on liability and enforcement are minimal and weak (Indicator 8). While the Cartagena Protocol on Biosafety establishes a non-compliance mechanism, the Convention does not establish one. National implementation remains a central (only) element to stimulate compliance and the establishment of liability rules.

Overall, an indicators-based approach has shown that the CBD does have elements to enable its applicability and adjustment to potential developments in geoengineering research, and possibly, deployment. But, owing to the limits emerged in our analysis, it seems that it is unlikely that it could represent a one-stop shop to regulating geoengineering at international level.

### London Convention and London Protocol on the prevention of pollution from dumping of wastes and other matters at sea (LC/LP)

As discussed in previous sections, the LC/LP is the other primary international treaty regime under which geoengineering has been actively considered, and thus is a prime candidate for the application of our indicator analysis.

Like the CBD, the London Convention and its Protocol allow for participation from all States and have a global geographic application with respect to dumping activities at sea, which would include ocean iron fertilization. While both include more specific objectives and obligations than the CBD, its implementation is still heavily reliant on a strong national implementation action (Indicators 2 and 4). This includes conditions for obtaining a dumping permit (following either a 'permitted unless prohibited' approach under the Convention, or a 'prohibited unless permitted' approach under the Protocol) and the designation of a national

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[139] See CBD SBSTTA reports at n 3 and 39 above.

[140] Cartagena Protocol on Biosafety to the Convention on Biological Diversity (Cartagena, 2000) into force 11.09.2003.

competent authority. However, no incentive mechanism is provided for under this regime. Such national implementation will also be critical for the geoengineering-relevant amendment adopted under the Protocol.

Decisions under the Convention and the Protocol are taken by majority of the contracting parties and a detailed amendment procedure is established.[141] The Protocol encompasses an expeditious procedure for amendments to the Annexes. This facilitates the framework's flexibility and adaptability to new scientific developments, such as the recently CCS-enabling amendments (Indicators 3). Overall, this is indication of the LC/LP's, future-proofing, which allows scientific developments to be embraced by the framework, without losing its consistency with its aims and objectives (Indicator 11).

The regime operates and evolves through the work of a series of treaty-bodies (Indicator 6). Decisions are taken by the consultative and special meetings of the contracting parties, which – as for the CBD- lack law-making power. These bodies are supported by a series of scientific groups, expert bodies and panels that ensure that new scientific findings and up-to-date scientific assessment is considered by the Parties and is reflected in their decisions and the regime's evolution (Indicator 8).

While there is no specific compliance mechanism under the Convention, the Protocol has established a set of compliance procedures and mechanisms in 2007 (Indicator 7).[142] These include a subsidiary Compliance Group that meets in parallel with the COP and provides advice on compliance issues. Like for other regulatory instruments, the inclusion of liability rules depends on national implementation establishing procedures for the assessment and the settlement of disputes.

State Participation and representivity is different between the Convention and the Protocol (Indicator 9). While the Convention has a good number of State Parties (87), including the US, and a good balance between developed and developing countries; the Protocol only has 42 parties, excluding the US. Should the 2013 amendments on marine geoengineering come into force, the Protocol's limited participation might be seen as a barrier to its wider legitimacy. Similarly to the CBD, no differential treatment is provided under the Convention, or under the Protocol between developed and developing countries (indicator 5). As explained above, this might be an issue should geoengineering activities result in disproportionate impact (e.g. environmental, financial, intergenerational equity) and responsibilities (e.g. reversibility measures) between developed and developing countries.

Participation of international NGOs is allowed under the regime, but has traditionally been limited (Indicator 10). This is not, however, a necessarily negative aspect as the few, specialised NGOs and organizations that have been involved in the negotiations have been influential in the decision-making process. In this context, these NGOs could also be granted consultative status, which enables them to e.g. make statements on agenda items, interventions in meetings, and participate in closed session meetings.

Overall, like in our analysis of the CBD, the application of an indicators-approach to the London Regime confirms that this framework has the ability to adapt to geoengineering developments within its scope of application. This element is one of the key features of the recent geoengineering amendments, which would

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[141] London Convention, art XV; London Protocol Art 21.

[142] See Compliance Procedures and Mechanisms pursuant to Article 11 of the 1996 Protocol to the London Convention 1972 (adopted in 2007: LC29/17, Annex 7).

enable new activities to be regulated under the new control mechanism in the future. The Protocol cannot however provide an ultimate one-stop shop for comprehensive legal and regulatory framework for all techniques.

## V. Decision-making and Enforcement: States, International Institutions and non-state actors

The analysis of the international norms applicable to all, or some, geoengineering activities implies the identification of appropriate decision-making authority and procedures; enforcement capacity and mechanisms; and a degree of legitimacy. In this context, a range of -more or less- suited international institutions and non-state actors are to be scoped, taking into account the abovementioned indicators.

### Treaty-based institutions

Should a top-down approach within a treaty-system be favoured, treaty-based institutions will be the governing bodies. The law of treaties and specific provisions of the relevant regimes will apply to both the creation of new instruments and the adaptation of existing ones. In this context, States enjoy full sovereignty in the creation of norms governing their reciprocal relations.[143] Once a treaty is in force, the role of the Conference of the Parties (COP) is primary, but complex. The COP is the governing body of almost all treaties, supervising their implementation and development, and, in some cases, enforcement. But States are only bound by their consent, apart from any formal and autonomous COP law-making authority. As a result, COP decisions are generally not legally binding for the Parties, unless they so decide. However these instruments remain influential in catalysing the treaty interpretation, strengthening and evolution. [144] In the geoengineering realm, such influence can be found in the CBD and the LC-LP COP decisions and resolutions on ocean iron fertilization.

The treaty itself would normally provide rules for its amendment, adoption of Protocols and amendment/adoption of annexes. Amendments or protocols are adopted by the COP generally by consensus (e.g. UNFCCC) or majority (e.g. LC/LP, as for the recent marine geoengineering amendment), while a simplified procedure is often applied for amendments of technical annexes.[145] Other treaty-related institutions are the Secretariat and subsidiary bodies on for instance, scientific, technical, and implementation matters (e.g. CBD and UNFCCC regime). The role of subsidiary bodies has been important for many technological developments (e.g. CCS). Scientific and technical advice emanating from them has increasingly played a considerable role in: developing an international research agenda; diagnosing environmental problems; assessing technical solutions and best practices; supporting production and exchange of knowledge; reviewing treaty implementation measures; and informing decision-making and

[143] See 1969 Convention on the Law of Treaties (Vienna) 8 *ILM* (1969) 689. In force 1980.
[144] The boundaries however are more fluid. See e.g. J. Brunnée, 'COPing with Consent – Law-making under Multilateral Environmental Agreements', *Leiden Journal of International Law*, Volume 15, Issue 1, (2002).
[145] See Bowman, 'The multilateral treaty amendment process – A case study', 44 *International and Comparative Law Quarterly* 540 (1995). See also special procedure for adjustment of stringency of control measures by 2/3 majority under the art 15 of the Montreal protocol, and Prior Informed Consent convention (Rotterdam Convention), art 7 and 9 and 22(5).

conflict resolution.[146] Their contribution will certainly be relevant for geoengineering decisions too.

Owing to the shortfalls of both state responsibility rules for environmental harm and civil liability regimes, softer enforcement procedures are normally preferred in the environmental field.[147] This includes recourse to international institutions, treaty supervisory bodies, and, in some cases, non-compliance mechanisms where established (e.g. the Montreal Protocol, Kyoto Protocol, Aarhus Convention). Compliance committees generally adopt non-binding decisions to be endorsed by non-binding COP decisions.[148] Dispute settlement remains a last resort option and its rules are normally provided for under the treaty regime (e.g. compulsory recourse to non-binding conciliation and other dispute settlement mechanisms under LOSC[149]).

Some have suggested the UNFCCC as a governance institution due to its universal membership and scope, although the limitations of its consensus-based decision-making and lack of trust in the process have been acknowledged.[150] The CBD COP has also been considered, but it lacks binding decision-making authority and enforcement powers and, as noted earlier, its competence is limited to conservation of biodiversity and sustainable use of its components. Similarly, ENMOD has limited participation and the COP has only met twice since the entry into force of the treaty, making ENMOD a 'sleeping treaty'. In the marine context, the LC-LP COP has clarified its authority to address ocean fertilization and has taken substantive steps in this direction. This is promising based on lessons learned from past legal developments on CCS in this setting.[151] Moreover, some have suggested that the United Nations Open-Ended Informal Consultative Process on Oceans and the Law of the Sea could 'provide a forum for the formulation of detailed and rigorous guidelines to govern the execution of scientific research'.[152] The Committee on Environmental Protection established by the Environmental Protocol of the Antarctic Treaty, and ultimately the Antarctic Treaty Consultative Meeting, have also been indicated as 'an ideal vehicle' to address the compatibility of ocean fertilization field trials with the Antarctic Treaty regime in the Southern Ocean. There is no treaty-based institution established under the Outer Space regime, but the UN Committee on the Peaceful Uses of the Outer Space might play a role in providing for guidelines.[153] With respect to SRM in the stratosphere, the Meeting of the Parties to the Montreal Protocol and the Executive body of LRTAP might also address these activities, but both regimes are

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[146] For a discussion, L.A. Kimball, *Treaty Implementation: Scientific and Technical Advice Enters a New Stage – Studies in Transnational Legal Policy No. 28* (ASIL, Washington DC 1996).

[147] For a discussion on the obstacles of State Responsibility and Liability regimes in environmental law, J Brunnée, 'Of Sense and Sensibility: Reflections on International Liability Regimes as Tools for Environmental Protection' 53(2),*International & Comparative Law Quarterly*(2004)351

[148] With the exception of the KP Compliance Committee Enforcement Branch. See in general, J. Brunnée, M.Doelle, L.Rajamani, (eds) *Promoting Compliance in an Evolving Climate Regime,* (CUP,2012).

[149] LOSC Part XV and Annex V (2).

[150] Lin, n 39 above; Barrett, n 55 above; Bodansky, n 45 above.

[151] For an analysis of these developments, see C.Armeni, 'Legal Developments for Carbon Capture and Storage under International and Regional Marine Legislation, in I.Havercroft, R. Macrory, R.B. Stewart, Carbon Capture and Storage – Emerging Legal and Regulatory Issues, (Oxford: Hart Publishing, 2011) 145.

[152] Scott, n 40 above, at 107

[153] Bodansky, n 131 above, at 318.

specific in scope and would fall short of furnishing a 'one-stop-shop' for regulation.[154]

## UN Specialised Agencies, UN GA Assembly Bodies and Intergovernmental Institutions[155]

A top-down decision-making process can also be conducted by a heterogeneous set of established international institutions. They normally lack formal law-making authority, but can create soft law norms, such as resolutions, declarations, guidelines, codes of conduct. Although generally not binding, these instruments have in many circumstances influenced behavioural change and even led to the conclusion of subsequent binding instruments.[156] In this respect, they could play a role in the governance of geoengineering techniques, even though their formal decision-making capacity remains limited. Yet these institutions have different mandates, structures, legitimacy and financial resources. As explained earlier, depending upon which geoengineering scenario is considered, their functions will vary.

With respect to environmental and climate matters, it has been suggested that United Nations Environmental Programme (UNEP), World Meteorological Organization (WMO), the Commission of Sustainable Development, or the Intergovernmental Oceanographic Commission of United Nations Educational Scientific and Cultural Organization (UNESCO) can become gravitational centres for the development of geoengineering rules.[157] A more peripheral role can be played by Food and Agriculture Organization (FAO), in the context of food security issues associated with enhancement of fish stocks. The International Maritime Organization (IMO) might implement its mandate to govern geoengineering activities at sea, while International Civil Aviation Organization (ICAO) might be involved in the control of aircraft-based SRM methods given its mandate to set standards and regulations for civil aviation.[158] Alternatively, suggestions for

[154] Amongst others, Redgwell, n 45 above, at 186. Nor is codification and progressive development of the international law applicable to the atmosphere likely soon to materialise from the work of the ILC: see first report at n 107 above.

[155] UN specialised agencies are international organizations established by treaty, but with a special relationship with the UN According with a special agreement with ECOSOC under Article 57 and 63 of the UN Charter. They include FAO and IMO, IFAD, UNIDO, and WB. UN GA Bodies are international institutions established pursuant art 22 of the UN Charter, such as UNEP. Intergovernmental institutions are established through cooperative arrangements between other international institutions (e.g. IPCC jointly established by UNEP and WMO; and GESAMP jointly established by nine UN organizations.). For an overview, see D. Bodansky, J. Brunnée, E. Hey, *The Oxford Handbook of International Environmental Law,* (OUP) 2007, Part IV, Actors and International Institutions.

[156] See e.g. IMO Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone 1989. See also UNEP, London Guidelines for the Exchange of Information on Chemicals in International Trade (revised 1989) leading to the conclusion of the Basel Convention; FAO, International Code of Conduct on the Distribution and Use of Pesticides (revised 2002) supporting the conclusions of the Rotterdam Convention on Prior Informed Consent.

[157] Bodansky, n 45 above, at 22. Scott, n 40 above. However, following the Rio+20 Summit, the CSD was replaced by a 'universal intergovernmental high-level political forum'. See GA Resolution 66/288, *The Future We Want,* (11 September 2012), para 84.

[158] However ICAO's role in climate change governance is limited. See J.Lin, 'The Role of ICAO in Regulating the Greenhouse Gas Emissions of Aircraft',*Carbon and Climate Law Review 4 (2011) 417.*While the potential role of both ICAO and IMO is acknowledged in the preamble to the KP, the latter has made considerably more progress in identifying climate change impacts within its remit, such as emissions from ships (see e.g.

governance under the United Nations General Assembly (UNGA), Organization for Economic Co-ordination and Development (OECD) and North Atlantic Treaty Organization (NATO) have made to mainly promote future international cooperation on geoengineering. [159]

As suggested above, in the long-term geoengineering methods might also fall under the radar of the WTO system (and its dispute settlement mechanism) insofar as a WTO Member adopts discriminatory restrictions on international trade on geoengineering-related goods and services; sanitary or phytosanitary measures affecting international trade, or violates intellectual property rights protection for geoengineering-related commodities or processes. In the latter case, the World Intellectual Property Organization (WIPO), which administers the main IP treaties[160] and support the development of international IP law, would also have the mandate to facilitate the adoption of instruments to address the IPR-related aspects of geoengineering.

Finally, intergovernmental institutions, such as the Intergovernmental Panel on Climate Change (IPCC) and the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) will not have a direct decision-making authority, but might be provide scientific and technical contributions to be taken into account. [161]

### Scientific Community, epistemic communities and NGOs [162]

The role of scientific experts in establishing guidelines and principles for conduct of scientific research would be propulsive for a bottom-up approach to governance. Despite criticisms, such as those on the conflict of interests of some participants or its non-reprensentivity,[163] an early example can be seen in the Asilomar Conference establishing the Principles for Responsible Conduct of Climate Engineering Research. These include: 'promoting collective benefit; establishing responsibility and liability; open and collective research; iterative evaluation and assessment; and public involvement and consent.'[164] Other actors, such as academics, might play an influential role in this field. This has already been demonstrated by the leverage of the Oxford Principles of Geoengineering Governance, endorsed by the UK House of Commons Science and Technology

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amendments to MARPOL Annex VI Regulations for the prevention of air pollution from ships, which entered into force on 1 January 2013 introducing mandatory measures to reduce GHG emissions from ships. Details available at: http://www.imo.org/MediaCentre/PressBriefings/Pages/01-MARPOL-EEDI.aspx#.VQFt96xFDIU)

[159] A. Carlin, 'Implementation and Utilization of Geoengineering for Global Climate Change Control', *Sustainable Development Law and Policy* Vol 7, Issue 2 (2007), 56-58.

[160] See e.g. 1970 Patent Cooperation Treaty (in force April 2002).

[161] GESAMP is an advisory body of the United Nations (UN) system on the scientific aspects of marine environmental protection. Geoengineering will be addressed the IPCC's forthcoming 2014 Assessment Report.

[162] Epistemic communities can be defined as "networks -often transnational- of knowledge-based experts with an authoritative claim to policy relevant knowledge within their domain of expertise'. See P.M. Haas, 'Epistemic Communities', in Bodansky at al, n. 4 above.

[163] E.g. E. Kintisch, 'Asilomar 2' Takes Small Steps Toward Rules for Geoengineering, *Science*, 2 April 2010: Vol. 328 no. 5974 pp. 22-23

[164] Asilomar Recommendations, n 81 above. See M.Leinen, The Asilomar International Conference on Climate Intervention Technologies: background and overview, *Stanford Journal of Law, Science and Policy*, May 2011.

Committee.[165] These are high-level principles intended to inform geoengineering research, development and deployment. They advocate for: geoengineering to be regulated as a public good; public participation in geoengineering decision-making; disclosure of geoengineering research and open publication of results; independent assessment of impacts; governance before deployment. Other initiatives are underway (e.g. draft code of conduct for geoengineering research). In the legal domain, the International Law Commission (ILC) has also been influential in developing draft articles and codes on the development of international law.[166] Being its object 'the promotion of the progressive development of international law and its codification', it is not unconceivable that the ILC might address some geoengineering-related activities in some form in the future.[167] Politically, though, this seems unlikely. Similarly a large network of NGOs might well provide additional stimulus for regulatory initiatives, within or outside international institutions.

## V. Regulation of Research vs. Regulation of Deployment

The question of when law should start addressing geoengineering is, in some respects, preliminary to any analysis on the content and function of regulation. This aspect points towards the distinction between research and deployment. The issues associated with such distinction have largely informed the international discussion on geoengineering regulation.[168] Two sets of legal questions arise in this context: first, whether there is – or there should be - a separation between these phases; and, second, whether there is- or there should be- a difference between the international rules and principles applicable to geoengineering research as opposed to those applicable to deployment.

In a number of specific contexts, international law distinguishes between research and deployment activities.[169] On this basis, some have stressed the desirability of such divide with respect to geoengineering, owing to the risks associated with the large-scale deployment of these techniques and their geopolitical and ethical implications.[170] A step-by-step approach from research to potential deployment appears more palatable.[171] Moreover, there is agreement on the fact that more scientific research is needed to inform the decision-making process before deployment, if any.[172] This approach is reflected in the decision of the Parties to

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[165] See S.Rayner, et al. 'The Oxford Principles', *Climatic Change* Vol 121 (3) (2013), 499-512. See also, C. Armeni and C. Redgwell, *Geoengineering Under National Law: A Case Study of the United Kingdom,* CGG Working Paper no. 23. March 2015.

[166] See e.g. ILC 2001 Draft Articles on Prevention of Transboundary Harm for Hazardous Activities in 'Report of the International Law Commission to the General Assembly covering the work of its fifty-third session, with commentaries, 2001' (UN Doc A/56/10), Ch V, in *Yearbook of the International Law Commission 2001*, vol II, Part Two (UN, 2001) ('Draft Articles on Prevention')

[167] Art 1(1) statute of the International Law Commission. On its current work on the law of the atmosphere, see n 107 above.

[168] Reynolds, n 48 above; Parson and Ernst, n 1 above.

[169] See for instance 1982 United Nations Convention on the Law of the Sea on marine scientific research, and 1959 Antarctic treaty on research vs. mineral exploitation.

[170] Reynolds, n 48 above.

[171] Peterson, n 46 above. See in this context, C. von Kries, G,Winter, 'Legal Implications of the step-by-step approach principle', *Environmental Sciences Europe (*2011) 23:32

[172] S.H.Schneider, 'Geoengineering: Could – or should- we do it?', *Climatic Change*, Vol.33, Issue 3, (1996)291-302;. See also Lauden and Thompson, n 2 above, and Uperlainen, n 16 above. Contra,, E.W. Schienke, 'Ethical Issues Created by Geoengineering Proposals – An initial analysis, (2007) available at

the LC-LP and the CBD, especially in the light of the LC-LP assessment framework for geoengineering research.[173] A call for adequate governance mechanisms before deployment is also at the core of some bottom-up initiatives. Other authors have nevertheless pointed to the risks and ambiguities of tracing an artificial boundary between the two phases.[174] This is especially evident for OIF and SRM techniques requiring unencapsulated, large-scale experiments in order to acquire data on the risks. In this context, it has been argued that 'geoengineering cannot be tested without full-scale implementation'.[175]

At first glance, such distinction appears of little significance if one considers that the two phases are likely to entail similar legal issues and regulatory responses. And yet, when it comes to assigning responsibility for damage, the legal test on the intention becomes highly relevant. Nevertheless, rules on the assessment and authorisation of the proposals, environmental impact assessment, monitoring, liability and responsibility for transboundary harm, and enforcement will be required for both research and deployment activities. For more conventional CDR methods, these aspects will most likely be governed by national law or under existing mechanisms. SRM and ocean iron fertilization, however, is more problematic owing to their unencapsulated nature and the lack of a global regulatory regime for the atmosphere. Some have indicated that unilateral deployment, dual-use, as well as the risks associated with the termination effect, make deployment a bigger challenge, from a legal and political perspective.[176]

## VI. Beyond the treaty indicators approach: the continuing role of customary international law

In applying an indicators approach to existing treaty regimes and identifying potential governance gaps, it is not the intention of this paper to suggest that a legal lacuna exists. State practice has given rise to a number of customary law principles of general application,[177] the most significant of which is the so-called 'no harm' principle. According to this principle, States have a duty to prevent, reduce, and control pollution and significant transboundary environmental harm arising from activities within their territory, jurisdiction or control. This principle has been enunciated in soft law declarations,[178] endorsed inter alia by the General Assembly,[179] the International Law Commission (ILC)[180] and in various multilateral

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http://www.personal.psu.edu/ews11/blogs/ce_import_test/2007/11/ethical-issues-created-by-geo-engineering-proposals-an-initial-analysis.html.

[173] Decisions adopted by the Conference of the Parties to the Convention on Biological Diversity at its Ninth Meeting (2008), IX /16 (C) 4. This approach has subsequently been reiterated by the parties in 2010 and 2012.

[174] E.g. D. Keith and K. Caldera, 'The Need for Climate Engineering Research', Issues in Science and Technology (2010) available at: http://www.issues.org/27.1/caldeira.html

[175] Robcock, n 51 above.

[176] Reynolds, n 48 above, at 130.

[177] See generally, N. De Sadeleer, *Environmental Principles: From Political Slogans to Legal Rules* (Oxford: Oxford University Press, 2002).

[178] See e.g. 1972 Stockholm Declaration of the United Nations Conference on the Human Environment, Principle 21; 1992 Rio Declaration on Environment and Development, Principle 2.

[179] 1974 Charter of Economic Rights and Duties of States, GA Res 3281, UNGAOR, 29th Sess, Supp No 31, UN Doc A/9631 (1974) 50, Art 30.

[180] 'International Liability for Injurious Consequences Arising out of Acts Not Prohibited by International Law (Prevention of Transboundary Harm from Hazardous Activities)' in 'Report of the International Law Commission to the General Assembly covering the work of its fifty-third session, with commentaries, 2001' (UN Doc A/56/10), Ch V, in *Yearbook of the International Law Commission 2001*, vol II, Part Two (UN, 2001) (Draft Articles on Prevention).

environmental agreements,[181] and in judicial decisions.[182] Thus, for example, in the *Pulp Mills* case, which involved the siting of a pulp mill on a shared watercourse, the River Uruguay, the ICJ observed that '[a] State is … obliged to use all the means at its disposal in order to avoid activities which take place in its territory, or in any area under its jurisdiction, causing significant damage to the environment of another State'.[183] This obligation not to cause *significant* harm has achieved widespread recognition,[184] particularly (though not exclusively) in the contexts of shared resources and of hazardous activities.[185] Shared resources are not a settled category; it has already been noted above that the legal status of the atmosphere is unsettled, and that this is only one of the competing concepts which might be applied. Similarly, it is unclear which if any geoengineering activity would constitute a 'hazardous activity' for the purposes of the application of this customary norm; but as noted this is not the sine qua non for the application of the no harm principle, with its emphasis on significant harm.

Assistance in determining whether this threshold of significant harm has been crossed may be derived from international undertakings by States, for example, to publicise national pollution release and transfer data[186] or certain types of activities which involve radiological, toxic, or highly dangerous substances may *a priori* be deemed significantly harmful.[187] The impact of other activities or substances may be unclear, hence in the application of a precautionary approach treaty regimes may combine an *a priori* determination of harmfulness (e.g. prohibition of $CO_2$ dispersal in the water column or on the seabed under OSPAR and of large-scale marine geoengineering under the CBD) with permitted areas of activity subject to an assessment and/or permitting framework (e.g. sub seabed disposal of $CO_2$ under OSPAR and of small-scale legitimate scientific research under the LC/LP).

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[181] See e.g., United Nations Framework Convention on Climate Change, adopted 5 May 1992, 1771 UNTS 107 (entered into force 21 March 1994) (UNFCCC), Preamble; 1992 Convention on Biological Diversity, Art 3.

[182] See e.g., *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, [1996] ICJ Rep 226 (*Legality of Nuclear Weapons*) at 241–2, para 29.

[183] *Case concerning Pulp Mills on the River Uruguay (Argentina v Uruguay),* [2010] ICJ Rep 14 (*Pulp Mills*) at para 101. See also the Draft Articles on Prevention, which accurately reflect the current state of international law in this regard, at 152. And, as noted by the ICJ in *Legality of Nuclear Weapons*, States have the general obligation to ensure that activities within their jurisdiction and control respect the environment of other States. See *ibid*.

[184] On this point, the ILC Draft Articles on Prevention accurately reflect the current state of international law in referring to the threshold of 'significant'. See e.g., Draft Articles on Prevention, at 152. The threshold criteria for their application are that the hazardous activity in question has 'a high probability of causing significant transboundary harm' or 'a low probability of causing disastrous transboundary harm' (Art 2(a)).

[185] It is acknowledged that there are disagreements between States over the identification of shared natural resources, and in particular on what, if any, rights and responsibilities flow in relation to such resources. International watercourses, migratory species and mountain chains, are some common illustrations. See e.g. and Convention on the Law of the Non-navigational Uses of International Watercourses, adopted 21 May 1997, 36 ILM 700 (entered into force 17 August 2014) (1997 Convention on Watercourses), Art 7; 'Shared Natural Resources' in 'Report of the International Law Commission to the General Assembly covering the work of its sixtieth session' (UN Doc A/63/10), Ch IV, in *Yearbook of the International Law Commission 2008*, vol II, Part Two (UN, 2008); *The Law of Transboundary Aquifers,* GA Res 63/124, UNGAOR, 63rd Sess, UN Doc A/RES/63/124 (2008), Art 6.

[186] See e.g., Protocol on Pollutant Release and Transfer Registers to the 1998 Aarhus Convention, an UNECE treaty now open to general participation, adopted 21 May 2003 (entered into force 29 October 2009) accessed 5 January 2015 at http://www.unece.org/fileadmin/DAM/env/documents/2003/pp/ch_XXVII_13_ap.pdf (2003 Protocol on Pollutant Release).

[187] See e.g., invasive alien species under the 1992 Convention on Biological Diversity; 1997 Convention on Watercourses,Art 21; and restricted pesticides and chemicals under the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, adopted 10 September 1998, 2244 UNTS 337 (entered into force 24 February 2004) (1998 Rotterdam Convention).

Finally, as noted above, 'territory' and 'any area under its jurisdiction' includes territory, internal waters, the territorial sea and the air space above; the EEZ if proclaimed (and any continental shelf extending beyond it to a maximum broadly of 300 nautical miles); and other areas over which jurisdiction may be exercised (e.g. for States party to the Antarctic Treaty, within the Antarctic Treaty Area). But the 'no harm' principle is not limited to geographic areas, as it also requires States to ensure that *actors* and *activities* under their jurisdiction and control do not cause significant harm to other States or to areas beyond national jurisdiction. Thus through the jurisdictional link of nationality, States may regulate their flagged vessels and registered aircraft wherever they may be (though subject to some extent to concurrent jurisdiction when in the jurisdiction of another State). So, a vessel on the high seas is in an area beyond national jurisdiction but the flag State may still regulate its actions, e.g. to prevent ocean fertilization activities. Similarly, though State sovereignty does not extend beyond its own air space, States may regulate their aircraft in the air space beyond, in the atmosphere, and in outer space. Here the jurisdiction link for the extension of regulatory authority is once again nationality – the State of registration of the aircraft (or satellite or space ship or space station[188])

## Obligations to Consult and Notify Transboundary Harm and to Conduct Environmental Impact Assessment

State practice further supports the customary law obligation to consult and to notify of potential transboundary harm, particularly where there are shared resources or hazardous activities being carried out, and the requirement to conduct a prior transboundary environmental impact assessment (EIA). In the *Pulp Mills* case, the ICJ found the requirement to conduct a transboundary EIA to be a distinct and freestanding obligation in international law where significant transboundary harm is threatened.[189] Although the specific content of such an EIA is left to the State's discretion, international law requires that an EIA is conducted and that it bears a relation to the 'nature and magnitude of the proposed development and its likely adverse impact on the environment'.[190] The requirement of an EIA is thus not an empty shell to be filled (or not) willy-nilly by the State proposing the potentially harmful activity. As the ILC has noted, '[t]he assessment should include the effects of the activity not only on persons and property, but also on the environment of other States'.[191]

The trigger for any requirement to conduct a transboundary EIA is 'significant adverse transboundary impact' from proposed activities. This is the requirement found, for example, in Article 2(1) of the Convention on Environmental Impact Assessment in a Transboundary Context (1991 Espoo Convention). Though clearly not directly applicable to non-parties, as the ICJ observed in the *Pulp Mills* case, the Convention may be used for illustrative purposes.[192] The threshold is a 'high degree of probability' of such adverse impact. As the 1991 Espoo Convention explains, EIA is 'a national procedure for evaluating the likely impact of a proposed

[188] It should be noted that some of these matters are also regulated by treaty e.g. apportioning liability between launch state and state of registration of satellites where harm is caused.
[189] *Pulp Mills*, n 183 above, para 204.
[190] *Ibid* at para 205.
[191] Draft Articles on Prevention, n 166 above, Commentary to Art 7.
[192] *Pulp Mills*, n183, paras 205, 210.

activity on the environment'.[193] Indeed, as the WP 3 working papers on the UK, Germany and the United States underscore, impact assessment is a ubiquitous feature of national law. The key criterion is the existence of a national procedure for the *ex-ante* assessment of the environmental impact of a proposed activity and, once undertaken, regular assessment. As stated in the *Pulp Mills* case, the scope and content of such assessment are for national law to determine in the absence of general international rules or specific treaty provision, subject to the requirement to exercise due diligence in conducting such an assessment.[194] This is where treaty assessment frameworks – whether embedded in binding treaty text or adopted via nonbinding COP decisions - can play an important role in ensuring both harmonisation of national measures and the application of appropriate standards and thresholds for assessment (e.g. the LC/LP assessment framework for scientific research on ocean fertilization).

There is thus a clear link between EIA and the exercise of due diligence. Indeed, there the ICJ found an EIA to be a necessary element of due diligence, which is interpreted so as to entail the 'adoption of appropriate rules and measures' as well as 'a certain level of vigilance in their enforcement and the exercise of administrative control applicable to public and private operators, such as the monitoring of activities undertaken by such operators'.[195] It further observed that 'it may now be considered a requirement under general international law to undertake an environmental impact assessment where there is a risk that the proposed industrial activity may have a significant adverse impact in a transboundary context, in particular, on a shared resource'.[196] In essence, the ICJ was applying the due diligence requirement in the flexible and context-specific manner suggested above.

As for the trigger for the application of any general procedural obligation of prior notification and consultation in good faith, once again it is that the activities in question may have 'significant adverse transboundary environmental effects' or the existence of an accident or emergency.[197] Under the only international treaty to address transboundary EIA, the 1991 Espoo Convention, where the trigger for assessment is (i) listing in Appendix I and (ii) likely to cause significant adverse transboundary impact, the additional procedural requirements of the Convention of prior notification and consultation presuppose the existence of such impact from the nature, scale and location of the activity to be undertaken. However, even where there is a duty to notify and to consult, such a duty does not entail the obligation to agree nor provide neighbouring States with a veto over the conduct of the activity contended to have adverse transboundary effects.

### Prevention and Precaution

While the principle of preventive action may be said to be well-established, more controversial is the customary law status of the precautionary principle or approach. Arguments range from lack of normative content to the absence of a uniform understanding of the meaning of the principle, and widely varying

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[193] 1991 Espoo Convention, n 92 above, Art 1(vi).
[194] *Pulp Mills*, n 183 above at para 205.
[195] *Ibid* at para 197.
[196] *Ibid* para 204.
[197] See e.g., Convention on the Early Notification of a Nuclear Accident, adopted 26 September 1986, 1457 UNTS 133 (entered into force 17 October 1986).

consequences of its application depending on the specific context. Whilst it may lack legally binding force as customary international law, its impact may nonetheless be considerable when further concretised in a treaty text (for example, the precautionary principle under the LC/LP)[198] or used as a 'general guideline' or aid to judicial interpretation of treaty obligations between the parties (for example, as was the case with the concept of sustainable development and the bilateral agreement between Hungary and Slovakia in the *Gabčíkovo-Nagymaros* case).[199]

In a wide-ranging assessment of the environmental consequences of deep seabed mining activities, the Seabed Disputes Chamber of the International Tribunal for the Law of the Sea (ITLOS) in an Advisory Opinion affirmed the obligation of sponsoring States to apply a precautionary approach, relying inter alia on provisions of the Nodules and Sulphides Regulations.[200] It was prepared to go further, however, in noting that 'the precautionary approach is also an integral part of the general obligation of due diligence of sponsoring States, which is applicable even outside the scope of the Regulations'.[201]

Apart from this Advisory Opinion, instances of international judicial recognition of the principle are muted and few. For example, there was no mention of it by the ICJ in the *Gabčíkovo-Nagymaros* case nor was it generally recognised as a principle of customary international law in the *Pulp Mills* case where the Court considered that 'a precautionary approach *may* be relevant *in the interpretation and application of the Statute*' between the Parties.[202] This statement is correctly regarded as 'fall[ing] well short of any confirmation as to the requirement of precaution in customary law'.[203] In the *Beef Hormones* case, the WTO Appellate Body found the legal status of the precautionary approach to be uncertain in general international law,[204] and eight years later in the *EC-Biotech Case*, a WTO Panel still found its status 'unsettled'.[205]

As a matter of general principle, Principle 15 of the non-binding Rio Declaration is phrased in very general terms and lacks the normative character of a rule of law.[206] Leading authorities have rightly expressed scepticism regarding the potential for the customary law status of the precautionary approach,[207] not least because '[t]here is no clear and uniform understanding of the precautionary principle among States and other members of the international community'.[208] Its

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[198] E.g. London Protocol, art 3.

[199] See V. Lowe, 'Sustainable Development and Unsustainable Arguments' in A.Boyle and D. Freestone (eds), *International Law and Sustainable Development: Past Achievements and Future Challenges* (Oxford: Oxford University Press, 1999).

[200] *Responsibilities and Obligations of States Sponsoring Persons and Entities with respect to Activities in the Area,* Advisory Opinion, [2011] ITLOS Rep 10 (*Advisory Opinion on Seabed Activities*) at paras 121–122, 125–127.

[201] *Ibid* at para 131.

[202] *Pulp Mills*, n183 above, at para 164 (emphasis added).

[203] P.Sands and J. Peel, *Principles of International Environmental Law,* 3rd edn (Cambridge: Cambridge University Press, 2012) at 224.

[204] *European Communities – Measures Concerning Meat and Meat Products* (1998), WTO Doc WT/DS26/AB/R; WT/DS48/AB/R (Appellate Body Report) at paras 120–125.

[205] *European Communities – Measures Affecting the Approval and Marketing of Biotech Products* (2006), WTO Doc WT/DS291/R (Panel Report) at para 7.89.

[206] 1992 Rio Declaration n 178 above.

[207] Birnie, Boyle and Redgwell, n 44 above, at 160–1.

[208] Sands and Peel, n 203 above, at 222.

application has chiefly been in consequence of treaty or other provisions which set forth the content and manner of its application binding only upon parties to that instrument and in that particular context.[209] Such treaty obligations between the parties requiring the application of the precautionary approach provide the necessary concrete guidance in doing so.

Even if applicable, the precautionary approach does not reverse the burden of proof, either as a matter of general principle, as the ICJ observed in the *Pulp Mills* case[210] or in treaties adopting a precautionary approach,[211] nor does it remove the evidentiary burden on a State to prove harm where such is alleged in a transboundary context. Its effect is limited to reducing the evidentiary standard required to prove that an activity poses a risk of harm. As ITLOS noted in its *Advisory Opinion on Seabed Activities*, and in what must currently rank as the high water mark of international judicial recognition of the precautionary approach, '[the due diligence] obligation applies in situations where scientific evidence concerning the scope and potential negative impact of the activity in question is insufficient but where there are plausible indications of potential risks'.[212] Thus, said the Tribunal, '[a] sponsoring State would not meet its obligation of due diligence if it disregarded those risks [as] [s]uch disregard would amount to a failure to comply with the precautionary approach'.[213]

In addition to these uncertainties regarding the legal status and effect of the precautionary approach at customary law, there are uncertainties regarding its application in the treaty context for the regulation of geoengineering. Applied to *averting catastrophic climate change* rather than to the effects of geoengineering itself, this principle could lead to balancing decisions ultimately in favour of geoengineering research, though if such demonstrates e.g. unacceptable risk to the environment then its application in the context of deployment of particular methods may lead to different results.

## Conclusions

There is increasing scepticism of the ability of current mitigation and adaptation strategies to effectively respond to climate change.[214] The mismatch between the proportion of the risk and scale of behavioural change, together with the low level of international/political ambition in emission reduction are hugely problematic. It is against this backdrop that some have presented the potential of geoengineering techniques as an insurance policy against the failure of conventional mitigation and adaptation. Acknowledging the uncertainties associated with most of these techniques, this paper has focused on the international legal and regulatory aspects of geoengineering governance. Attention has been focused on the main

[209] See e.g. UN Agreement Relating to the Conservation and Management of Straddling Fish Stocks and Migratory Fish Stocks, 34 *ILM* 1542 (1995); 1996 London Protocol.
[210] *Pulp Mills*, n 183 above, at para 164.
[211] See e.g., Stockholm Convention on Persistent Organic Pollutants, adopted 22 May 2001 [2004] ATS, 40 ILM 532 (2001) (entered into force 17 May 2004) (2001 Stockholm Convention); 1995 Fish Stocks Agreement n 209 above.
[212] *Advisory Opinion on Seabed Activities*, n 200 above, at para 131.
[213] *Ibid.*
[214] Energy Technology Perspectives 2012 (ETP20120. The current trend of increasing emissions is unbroken with no stabilisation of GHG [greenhouse gas] concentrations in sight." It projects that if this continues, "energy use will almost double in 2050, compared with 2009, and total GHG emissions will rise even more. Long-term temperature rise is likely to be at least 6C."

arguments and key questions explored (or ignored) by the international legal literature. That is the *what, why, whether, how, who and when* of geoengineering governance. Certainly, these are not entirely new questions. There is a wide legal experience of governing other potentially harmful technologies, such as GMOs, nanotechnologies, chemicals, and nuclear power. However, three conclusions can be drawn with respect to the specific challenges of geoengineering, which seem to have been discounted under the present debate.

First, a one-size-fits-all governance framework for all geoengineering methods appears unfeasible, not to mention politically unlikely. The notion of geoengineering refers to a very diverse group of more or less new techniques. Their diversity relate to the activities and substances involved, the stage of technical development, the geographic areas in which they can be deployed, scale and seriousness of impact, and reversibility. This variation appears irreconcilable within a uniform legal and regulatory framework. In this context, the analysis of the current geoengineering debate goes somewhere towards acknowledging that the legal and regulatory response to a future development of these methods will necessarily be fragmented and multifaceted, combining soft law initiatives with the adaptability of some existing frameworks, against the backdrop of customary international law and general principles. Moreover this fragmentation is likely to be reflected at the institutional level. Here, top-down decision-making process within treaty-bodies or at the international institutional level will need to acknowledge, and coordinate with, bottom-up governance initiatives originated from scientific communities, non-governmental organizations and other interested non-state actors.

Second, it has been pointed out that the international legal scholarship analysed in this paper concentrates almost exclusively upon the climate purpose and environmental implications of geoengineering techniques. A deeper consideration for dual-use and its associated multiple governance frameworks – international security, food security, international trade, intellectual property rights, ethical and sustainable development concerns – is essential to appreciate the full range of legal and regulatory challenges involved.

Last, but not least, the questions extrapolated from the legal debate on governance models for geoengineering have revealed a tendency to assess a merely formal applicability, or adaptability, of existing treaties to these techniques. We see this as too limited an approach, which dismisses the wider context in which these treaties are negotiated, implemented and enforced in practice. From a perspective that 'form ever follows function', it has been suggested that an assessment based on a set of agreed indicators might be more valuable. The legal force of a treaty; the precision of its obligations; its decision-making rules, any regulatory instruments and incentives; the distribution of responsibility; its treaty-based institutions; the liability and enforcement; the role scientific input in the decision-making; the degree of State and non-state participation and representivity; and its "future-proofing" nature, if any, have been presented as suitable indicators. This revised approach would allow a more real-world consideration of the success of an international treaty in fulfilling its function and achieving its objective. This is viewed as a preliminary condition to then evaluate its formal, or desirable, applicability to govern *individual* geoengineering techniques. Moreover, as the Annex to this paperdemonstrates, no single treaty regime scores highly on all of the indicators applied, suggesting that calls for the CBD (or any other single regime we have considered) to take a lead role in the governance of *all* geoengineering is at best premature and at worst misguided. Finally, as this paper has argued, the absence of global regulatory frameworks for geoengineering techniques (other than that emerging for ocean fertilization) does not necessarily lead to the conclusion that there are no international legal norms of application to geoengineering activities, wherever they take place. This is owing to the application of general customary law norms buttressed by the exercise of jurisdiction on the basis, inter alia, of nationality (eg of ships and of aircraft) and/or territoriality. Nevertheless, the specificity of e.g. the LC/LP treaty regime for marine geoengineering stands in stark contrast with the relative generality and uncertainty surrounding customary rules and their application to e.g. SRM activities in the atmosphere. Finally, as argued above and explored in the further working papers in this package, national law will have a key role to play particularly in the governance of encapsulated geoengineering techniques. Subsequent working papers explore UK, German, and (selected jurisdictions under) US law respectively.

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An Annex to this paper, *Assessment of International Treaties Applicable, or at least Adaptable, to Geoengineering-Related Activities through Indicators*, is published separately in this series as CGG Working Paper 22.